Instruments

THE MAGAZINE of MEASUREMENT and CONTROL

Vol. 22 DECEMBER 1949 No. 12

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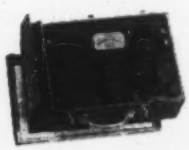

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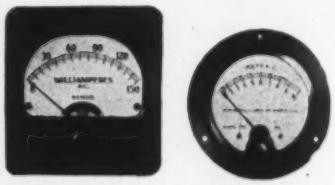

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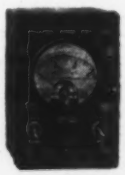

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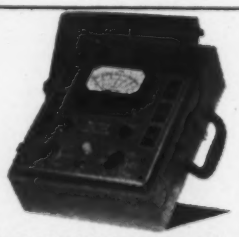

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Instruments THE MAGAZINE OF Measurement and Control

M. F. BEHAR, Editor

You Can't Eat Your Cake and Have It

"It is often for an excuse that we say things are impossible." —*Mirabeau.*

"'Impossible' is a word to be found only in the dictionary of fools."—*Napoleon.*

* * *

"You can't . . . "—*First two words of many proverbs, maxims and old saws epitomizing the wisdom of the ages.*

"It is impossible for a 24-gage wire at 70 F. ambient to conduct 1000 amperes; it is impossible for a 0.1-in. nozzle to discharge 1000 gpm. of hydraulic-cylinder oil."—*Two of the countless impossibilities derived from the immutable laws of Mother Nature.*

IN recent years the December *Instruments* editorials have been devoted to predictions for the ensuing years. Some predictions were easy deductions from signs easily observable to anyone with what is known as "connections." Other predictions required what is commonly called "sticking out one's neck." All came true.

Strong, therefore, was the temptation to fill this page with predictions for 1950. Easy would have been the chore of writing from notes jotted down in recent weeks. Pleasant was the prospect of seeing the prestige of *Instruments* grow still greater next year.

But other notes jotted down in recent weeks (and impressions even more vivid, perhaps, because not jotted down) led to the conclusion that the interest of subscribers —and of plants and labs where subscribers are employed— would best be served by a preachment devoid of sugar-coating—by a blunt sermon calling attention to a deplorable tendency—to an unreasonable new attitude on the part of many instrument users, including some prominent and respected experts.

This attitude is to DEMAND the impossible from measurement and automatic-control devices—or from their designers and builders—or to ATTEMPT the impossible.

This attitude is never justifiable; but it is partly excusable, in many cases, by a growing belief that measurement and automatic-control devices have been developed to a state of perfection approaching the human brain—yes, surpassing the human brain in many respects, so that to them may be applied the motto of the Seabees: "The difficult we do today; the impossible takes a little longer."

The aim of this preachment is not to deride the spirit of progress or inventiveness. On the contrary, it is to ACCELERATE developments by reminding our subscribers that the word "impossible" has different meanings in the emotional realm of eloquence or poetry and in the physical world of science.

But enough of generalities. Our specific preachment on this occasion is to exhort our readers to keep in mind two principles—old in the back-of-the-mind of Instrument Men but never yet explicitly stated. These principles are:

(1) The MUTUAL EXCLUSIVENESS of certain measuring properties and performance characteristics;

(2) The INTERDEPENDENCE of certain measuring properties and performance characteristics.

To illustrate the principle of mutual exclusiveness, a few vivid examples may be cited from technical fields other than Instrumentation: A watchmaker's lathe and a freight-car wheel-and-axle lathe cannot be combined into one machine tool. An automotive vehicle cannot combine the speed of a racing car, the strength of a bulldozer and the silence and comfort of a limousine. A jet plane can't hover like a blimp. A submarine can't fly.

Similarly, in the field of Instrumentation, a temperature controller bulb-and-well assembly designed to withstand the severe abrasion and corrosion of a pulp digester will have a characteristic time of about half a minute; and a pulp-and-paper chemist who insists on installing a fast (say one-second) bulb will find that such a bulb will be destroyed before the day is over.

To illustrate the principle of interdependence, one need not go outside the field of Instrumentation for three well-known examples: (1) An automobile ammeter priced at fifty cents in lots of a thousand, and with a scale length of one inch, will probably have an accuracy of six percent of its scale range. (2) A laboratory ammeter priced at $500, provided with knife-edge pointer, antiparallax mirror, etc., etc., and with a guaranteed accuracy of 0.5 percent of its scale range at mid-scale, will probably have an accuracy of 0.2 percent at mid-scale and 0.1 percent in the upper third. (3) If the Unit Sensitivity of an instrument is one scale division, the Accuracy of that same instrument cannot possibly be better than one scale division.

Some instrument companies have extended the standardization of their products and have courageously announced: "If you want such-and-such a modification, to obtain such-and-such a characteristic, we will no longer try to supply it alone, but we will supply only the combination of the following characteristics: . . ." We declare that hasty criticism of these companies is unjust. We salute them!—MFB

P.S. About fifteen years ago we quoted Dr. McDonald, Director of the Franklin Institute Biological Laboratory, as declaring that duplication of effort was "THAT CRIME AGAINST RESEARCH," and we urged subscribers to resist the "Let's Build Our Own" temptation. There's even less excuse for such wasted effort today, because instrument makers (nearly 1500 of them) can almost always supply what is believed to be a new device. Before you decide to design and build your own, look up your copy of *The* 1950 *Instruments Index* and write to a number of companies. Remember also that if what you need wasn't available yesterday, it may be on the market today. This month our "New Instruments" Department has ninety-six items—a new record; and the 799 items in our twelve 1949 issues also set a new record . . . and the 828 items of Manufacturers' New Literature we ran this year also set a new record!

ISSUES

The Counter Reads 0 0 2 6 4

and thereby registers the end of the twenty-second year of *Instruments'* service to users of measurement and control devices—service to

THE UNITED STATES OF AMERICA

The entire staff of *Instruments* wishes you

A Merry Christmas and a Happy New Year

A Centralized Organization *for* Instrument-application Research

By J. G. KERLEY, Manufacturing Dept., Shell Oil Co., Inc., New York.

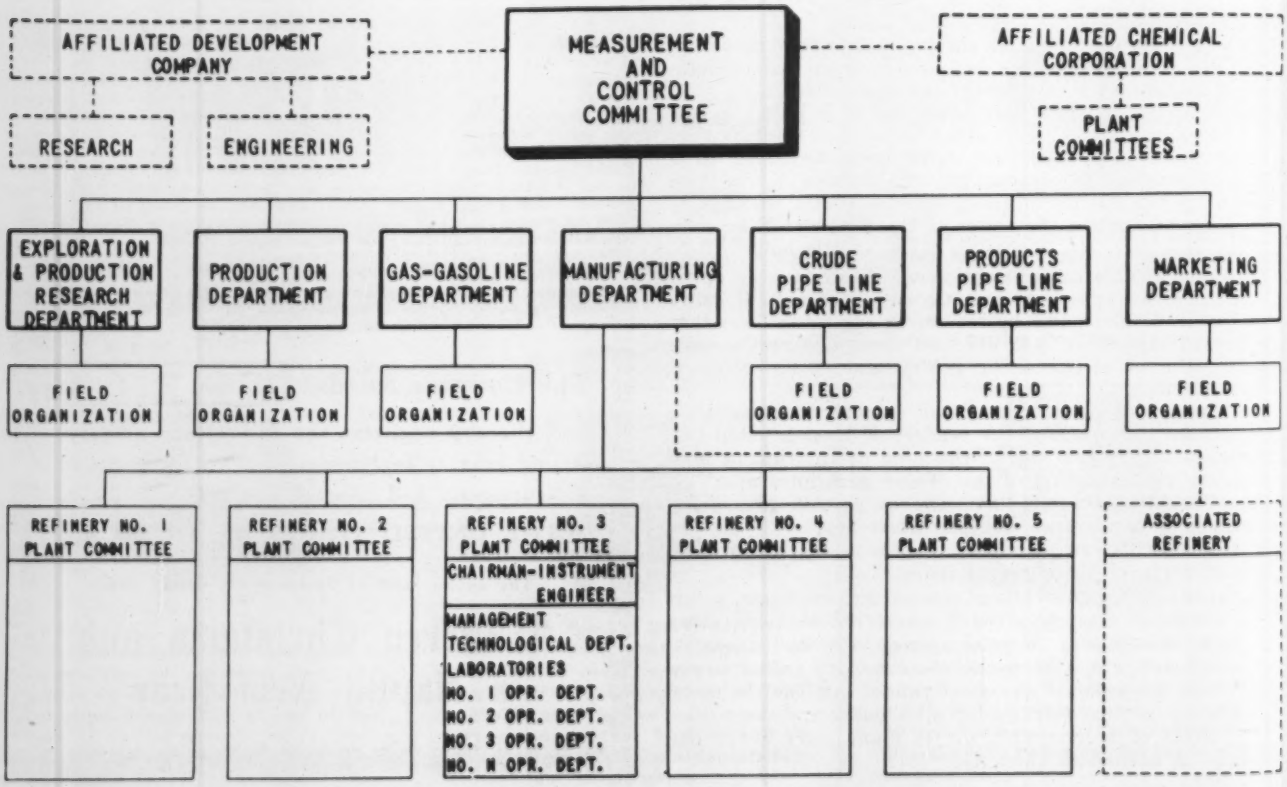
EARLY in 1945 the top management of Shell Oil Company, Inc., instituted in its East-of-the-Rockies area a group of engineers representing all phases of the winning and refining of petroleum, as well as the distribution of petroleum products, whose broad duty was defined as "the promotion of the use of measuring and controlling equipment and other automatic devices in the oil industry". Roughly, this duty can be divided into two functions: the first is to examine all new measuring and controlling devices as well as special apparatus such as electronic equipment to see how they can be used to reduce costs and improve product quality; the second is to survey the field operations of each department to see what equipment can be mechanized and made automatic as well as to see how existing operations can be improved by better measuring and controlling equipment.

The organization chart for this group is shown on this page. Let us examine the committee proper before going on to the field extensions. As shown, the group was titled the Measurement and Control Committee. A Chairman was selected from the Manufacturing Department and located in the Head Offce. He is the contact man for this group, and devoting practically full time to these duties, compiles information on all new developments, distributes it to the organization, acts as consultant on experimental application problems, and administers the affairs of the committee.

Membership is made up of delegates from the following departments, whose duties are roughly abbreviated and simplified as follows: (1) the Exploration and Production Research Department who find likely locations for crude oil under the surface of the earth; (2) the Production Department who drill down and bring the oil to the surface; (3) the Gas-Gasoline Department who perform certain processing operations on the oil in the field; (4) the Crude Pipe Lines group who transport the oil to the refineries; (5) the Manufacturing Department who refine the crude to petroleum products; (6) the Products Pipe Line who transport the products to centralized bulk stations; and (7) the Marketing Department who distribute those products to the consumer. These represent all the major operating sections of a large oil company but in addition, the research and engineering sections of the affiliated Shell Development Company were invited to participate, as were the affiliated Shell Chemical Company and the associated Montreal Refinery of Shell Oil Co. of Canada, Ltd.

The delegates from these departments are all research men and engineers of considerable stature in their organization, usually "main office men." As stated before, the principal duties of this group are the proper dissemination of useful information and the solution of specific problems. Although a certain amount of benefit could be derived by stopping the organization at this point, it was appreciated that problems seldom arise, and are practically never solved, at polished main-office desks. Likewise, to benefit most from new equipment, information regarding it should be passed on out to the operating areas where it can best be evaluated for use. As a result, at the same time that the central committee was set up, each participating department was encouraged to establish a field organization designed to carry the committee functions out to the man who does the work in the operating area. Details of the organization for these field groups differ. Actually, each is designed to meet the needs of the specific department.

To exemplify organization of the field groups we have shown an organization chart of a typical refinery committee. Note that the Instrument Engineer acts as Chairman and that there are representatives from Management, the Laboratories, the Technological Department and each operating department on this committee. Meetings are



usually held monthly. Sometimes the Operating Department representatives are the Department Managers in person. In other cases they are technical assistants. In any event, they usually are of a caliber sufficient to recognize the need for new equipment in solving the problems of the particular department.

Let us follow the handling of an imaginary problem. The representative of Operating Department No. 2 decides that if he had a certain type of chemical composition analyzer with a continuous recording feature it might save him money in consumption of certain treating chemicals. At the next monthly meeting he brings this topic up before the local plant committee where it is discussed and the experience and knowledge of all the other departments are available for his assistance. If a suitable solution is arrived at, the fact is noted in the meeting minutes that are circulated to the other refineries, the Chairman of the central committee, and other interested parties. If a suitable solution is not reached, the problem is referred to the central group. The central group then makes a survey of existing equipment to see if any is suitable. If none is, it surveys farther to see if existing equipment can be modified to fulfill requirements. If it appears that this cannot be done and that special equipment must be designed, the central group appeals to the research section of the Development Company. This group may elect to do the work themselves or they may suggest farming out the job to an organization specializing in problems of the particular kind involved. Owing to the unusual nature of the equipment needed, usually the former course is followed.

When the equipment arrives and is installed, a careful record of its effectiveness is kept, and the entire organization is kept informed by progress reports at the central committee meetings. When the experiment is concluded, a completion report is written in detail and included in the proceedings report of the central committee.

So much for one of the committee's functions, problem solution. Before leaving the subject, however, it is well to remember that this organization *specializes only in application research.* It is concerned in trying out instruments—not designing or building them. If a man in the field gets an idea for an instrument, he may do enough work to assure that his idea is workable; but once he has done that he passes it through the committee to the Development Company where research is finalized and the instrument designed. This, you will recognize, prevents a lot of miscellaneous disconnected "puttering" which is usually time-consuming and which, if it results in instruments at all, results in instruments of poor quality. It is our belief that such "puttering" is a very effective way of assasinating good ideas, and we adhere to this rule despite the fact that everyone likes to "putter".

Now let us look at the other broad function, dissemination of information

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"Of the many kinds of officers of large corporations, there is the kind that remains instrument-blind. Their numbers dwindle . . . At the other extreme—the happy extreme—are the officers who not only see Instrumentation's possibilities but take a cordial interest in their Instrument Men and manifest this friendly interest by their policies and actions.

"What better example of policies and actions than to have Instrument Men from the company's scattered plants and labs go to an ISA conference and remain together several days afterward for an 'idea conference' of their own?

"Shell is one of the happy companies blessed with such managerial vision.

"All expenses paid? Certainly! 'Convention' atmosphere? Certainly NOT! No participants we saw at Philadelphia kept busier than the Shell men: they seemed to be on active duty twenty-four hours a day!"

—From an *Instruments* editorial

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on new equipment. As stated before, a good portion of the Chairman's time is taken up in contacting equipment manufacturers and others to keep abreast of all new developments. Likewise, each delegate to the central group is charged with the duty of keeping abreast of developments in his own particular field. This, of course, results in considerable information of varying value which must be filtered out by discussion through the channels of the organization. It was appreciated, when the organization was set up, that discussion alone is a very poor method of evaluating new equipment. Although we want to use every new device present in the design of operating plants, we don't want to buy any "pigs in pokes." To assure that the new device will work, it should be tried out and evaluated. As a result, each department sets aside a relatively small sum to be used each year for evaluating new equipment.

For instance the Manufacturing Department has set up a fund known as the Engineering Research Budget which is administered from Head Office and used solely for the trial of new equipment. If a new device comes to light that seems to have good promise for future designs, Head Office may request one of the refineries to try it out and evaluate it. Research Budget funds are used to defray whatever expenses are incurred by the plant trying out the equipment. These expenses vary, depending upon agreements reached with the instrument manufacturers. It is our preference to purchase equipment outright for trial; however, the manufacturer sometimes feels that the product is still in the development stage and prefers to supply it without cost so that he may benefit from plant experience in disclosing the "bugs" almost inevitably present in new equipment. Agreements vary between these two extremes. If we install experimental apparatus with a special aim in view, we usually purchase it, try it, determine what is wrong, modify it to overcome the difficulty and try it again. This process is continued until the equipment is suitable or abandoned. If the equipment is installed simply to determine its worth, it usually is tried out on several services. Needless to say, the reports on this equipment are, like the previously-mentioned ones, prepared for inclusion in the central committee's proceedings reports.

Incidentally, these Research funds are used also to finance trial of equipment suggested by the field in cases where the Operating Department feels that such trial is too big a gamble to be financed through conventional channels. In such cases, if the equipment fails to perform the required duties, it is removed and the expenditure charged off to profit and loss. On the other hand, if it is successful, the Operating Department involved capitalizes the equipment and returns the funds to the budget.

This briefly explains the principal functions of this group. It was inevitable, of course, that in order to discharge its primary duties, this committee would become interested in other functions such as standardization, education of personnel, etc. Such an organization lends itself well to the promotion of these movements; and some beneficial results in these auxiliary fields have been realized.

Information on meeting of the central group has been left for the conclusion. Meetings are normally attended by the delegates from all of the departments shown on the organization chart, including one or more from each of the refineries. Other field groups are quite often represented and there generally are a few visitors on hand from associates abroad. Each department supplies a prepared report covering completed projects in detail and summarizing current findings on all projects in progress. These reports are bound into a volume known as the Proceeding Reports and distributed through the company and to associates requesting them.

As to frequency of meetings, owing to the large number of "top drawer" problems held over by the manpower shortage during the war, four meetings of this group were held during the first year. These were later reduced to two per year and, as the group gradually finished its groundwork and settled down to actual experimental application, meetings were reduced to one session of the central committee per year augmented by an interim meeting for each participating department. The departmental interim meetings are usually held in the Spring and the annual general meeting is held in the Fall in conjunction with the annual Conference and Exhibit of the Instrument Society of America so that the delegates can study at first hand the equipment on display and discuss its possible use immediately with their fellow-members.

Unit Start-ups *and* What They Can Teach *the* Instrument Engineer

By J. W. GRAEB, Imperial Oil Ltd., Sarnia, Ontario, Canada.

NOTHING can be taken for granted—this is the most important lesson learned from participation in unit start-ups. Much of the trouble encountered during start-ups could be avoided if those responsible were absolutely sure that all equipment was installed according to design and that it was in a satisfactory operating condition, instead of *assuming* that it was.

These remarks apply, of course, to all equipment on a new unit—instruments, exchangers, pumps, valves, lines, process vessels, etc.; and instruments are not the only offenders in causing inconvenience or delay to a start-up. But the fact that equipment over which he has no control may cause start-up trouble does not relieve the Instrument Engineer or Supervisor of any responsibility in making sure that his instruments are in as near-perfect shape as it is possible to get them.

Start-ups of new units may be divided into three groups:

1. In which the unit is started by the contractor and turned over to the owner after it is operating.
2. In which the unit is designed and constructed by others, but started up by the owner.
3. In which the unit is designed, built and started up by the owner.

To be sure, there are some advantages to the owner in taking over a unit in operating condition; but the disadvantage is that most of the valuable experience of starting up the unit has been gained by the contractor's start-up crew rather than by the permanent operators. This discussion will apply primarily to the second type of start-up, although it will apply to a lesser extent to the other start-ups as well.

Eternal Vigilance

If we accept the introductory statement that nothing can be taken for granted, then it follows that everything must be checked to make certain that it is installed properly and in good operating condition. That this condition is essential to a smooth, trouble-free start-up is obvious; and it would seem axiomatic that no attempt would be made to start a unit up until every detail had been checked. That this is, unfortunately, not the case, is only too evident during start-up periods.

To prove that eternal vigilance is necessary, it might be interesting to list a few personal observations:

Orifice-type flow meters have been found with the lead lines reversed, with the taps not drilled through the pipe, with no mercury in the meter body, with no orifice plate installed, with the orifice plate in backwards, with the gasket completely covering the orifice and a hole poked through by a screwdriver.

Control valves have been installed backwards, have been plugged with scale and dirt, have been jammed tight by welding slag or pieces of wood, have had their action the reverse of what it should be.

Thermocouples have been connected to the wrong switches or had their leads reversed.

Controllers have been found with the wrong action, with the air connections reversed, and with the control mechanism not lined up.

Valves have been left off, and plugs left out, and sometimes the unplugged hole has been covered by insulation.

Some of these errors were observed and corrected before the unit started up, others were not discovered until later. Some are of a relatively minor nature and were corrected; with others it was necessary to shut the unit down before corrective action could be taken. But the significant point is that all of them might have been found and corrected prior to the start-up.

It might be argued that the contractor is responsible for all installation work and should see that the instruments are properly connected and in operating condition when the unit is turned over to the operating crew. While this is no doubt true, some contractors are not as competent as others, and some may not have a qualified instrument foreman or engineer on their construction crew. Even the best can slip occasionally. If a unit start-up is delayed by inoperative instruments, it profits little to blame the contractor, when the delay could have been avoided by a closer check-up on the part of the owner's instrument supervisor.

Complete Inspection

The formula for elimination of instrument troubles during start-ups would seem to be a thorough inspection of every part of each instrument installation by the instrument engineer or his competent assistants during the construction period, plus a complete and thorough calibration of each instrument just prior to the start-up. Nothing should be taken for granted. If process lines are washed out or blown out, control valves should be removed during the clean-out period and inspected. If this is not done, or if the lines are not cleaned out, trouble may be expected at the control valves during the start-up and later.

It may not always be possible to follow this formula as closely as desired. If the instrument engineer and his crew have other units to maintain at the same time, it may not be possible to spare the personnel to follow the construction on a full-time basis, and on a new unit of any considerable size the instrument inspection during the erection period is a full-time job for at least one man. Owing to the necessity of getting the unit on-stream as soon as possible, sufficient time may not be available between the completion of the installation and the start-up to completely test and calibrate the instruments, controllers, transmission systems, etc. There is always the possibility that too much hurry to get the unit on stream in the first place may be more than offset by delays and shut-downs during the start-up, which could have been prevented by allowing for more inspection time. Even if the formula for a trouble-free start-up is followed in spirit as well as in letter, there are bound to be some troubles during the initial operations—troubles caused by a combination of human nature and "the ineradicable perversity of inanimate objects." Any departure from the high standard of the formula will increase the troubles beyond the irreducible minimum. The number of troubles and difficulties encountered during the start-up period bears a definite, inverse relationship to the amount of time devoted to inspecting and checking the instrument installations prior to start-up. Of course, it is realized that the law of diminishing returns will help determine the point at which it is no longer practical to delay the start-up, in order to correct the last-minute oversight.

The Instrument Crew

Although this discussion is not intended to dwell at length on the training and disposition of the instrument staff, the effect on the start-up of their ability and availability cannot be ignored. Certain observations from actual start-ups may be pertinent. If the Instrument Engineer can staff the new unit with trained, experienced men without weakening his organization elsewhere, he is very fortunate. However, the problem is frequently complicated by the fact that the new unit or units may represent a major plant expansion or an entire new plant and the Instrument Department prior to

* Presented before the New Jersey Section, ISA, March 1, 1949; and at the ISA Regional Meeting, Toronto, Canada, May 12, 1949.

expansion may have been very small or non-existent.

Although the most competent instrument men available should be used for starting up the instruments on a new unit, a creditable start-up can be achieved with relatively inexperienced men. The best possible experience for a new instrument man is to assist in the start-up of a new unit. It is, of course, a decided advantage if he can be given a thorough grounding in the theory of measurement and control prior to the start-up. Some experience on "dead" instruments is also to be preferred.

Train BEFORE Start-up

The instrument crew that is to start up the new unit should be allocated full time to that unit as far in advance of the actual start-up as possible—several weeks or a month being not too long on a large or complicated unit. This will serve a dual purpose: The men can be employed in checking installations and calibrating equipment (which work has to be done anyway) and at the same time they are learning the unit and getting experience with the functions of the instruments. Time should be allowed for the instrument men to familiarize themselves completely with the process—what it is, where the various pieces of equipment are located, how they function, and where all the important piping is located. It is one thing to be shown the location of a certain line or control valve on a process diagram, and another to locate it in a maze of piping on the unit itself. To minimize trouble during the start-up, the instrument men must know the location and function of every instrument and valve on the unit. This cannot be learned the last day before the start-up. An emergency is no time to be leafing frantically through a book wondering how an instrument is supposed to work, or dashing from valve to valve in the dark, peering desperately at labels with the pious hope that the right valve won't be the last one to be looked at.

A lecture (or series of lectures) on the process and instruments, given by the Instrument Engineer to his crew prior to the start-up, has proved valuable. It should be sufficiently detailed for the men to get a thorough knowledge of the process and how it is controlled. This specific lecture course will be of more value than having the men attend any lectures about the unit which are designed mainly for the operating group. A specially-prepared instrument manual, listing every instrument and valve on the unit, with its function and other pertinent information such as range and operating conditions, is of great benefit. Included in this manual should be a good process diagram or flow sheet, and descriptions of all peculiar, or non-standard, instrument installations. The material presented in the lecture course could well be included in the manual. Every instrument man should have his own copy of this manual if the maximum benefit is to be obtained. A second manual, containing a complete file of manufacturers' literature and operating instructions for all instruments on the unit, could be assembled and permanently located in the control room.

It is the author's firm belief, based on personal observations, that nothing is gained, and a great deal lost, by withholding from the instrument mechanics any information pertaining to the job. A well-informed crew will be an alert and interested crew, able and willing to think for themselves, instead of standing about dumbly, waiting to be told the next move. The attitude of the men to the job can go a long way to make up for lack of previous experience, and will determine the value of the experience gained on the present job.

It is impossible to provide any "magic factor" which will easily and quickly determine the number of men required for the start-up. It probably will be necessary to augment the regular crew, which has been allocated to the new unit, with a few extra mechanics. If well-qualified men are not available, it may prove advantageous to have the regular crew work long, overlapping shifts, thus providing the effect of a double crew. It is felt that this course is preferable to bringing in a group of extra mechanics who have no knowledge of, or experience with, the unit, unless the work of the extras can be very closely supervised by the Instrument Foreman, or unless they work as helpers with the regular crew. Of course, the amount of extra work requiring an enlarged start-up crew will depend to a considerable extent on the thoroughness of the pre-start-up inspection and testing.

Design and Application

Much can be learned about the design of control systems, and the application of different types of instruments, from taking part in a start-up. If the same engineer who designed the instrumentation also supervises the start-up he will be in an excellent position to have his decisions verified, or learn first-hand, and quickly, about his errors in judgment. Frequently, however, the Design Engineer may have no direct contact with the Instrument Engineer in the plant. The former may never get to know how satisfactory, or otherwise the instrumentation is, but an occasional reddening of the ears may indicate what the Field Engineer is thinking of him.

Field Performance

The engineer who does the design work should be given the opportunity of observing, or taking part in, the start-up of at least some of the units for which he has designed the instrumentation. Only in this way can he keep his practical knowledge of his field up to date. Without this practical experience, he is prone to perpetuate outmoded types of instruments and methods of control, or go to the other extreme of trying every new gadget that comes to his attention without giving thought to field performance. *Instrument engineering cannot be done in an ivory tower.*

Field observations will help provide the answer to many problems which either do not exist, or are insolvable, to the Design Engineer. Two different makes of controllers may seem equally satisfactory on paper, but may be altogether different to the mechanic who has to service them. Field observations alone will determine the value of new design features on instruments and valves. Problems such as the correct design of weatherproof instrument housings, and the necessity of control-valve housings, will be nearer solution after personal observation. A nice compact design for an instrument housing loses much of its value if it does not permit ready access, without undoing a lot of bolts to all parts of the instrument; or if the instrument mechanic burns himself on the heating coil every time he tries to do anything more than open the door.

Other questions to which start-up observations help provide the answers are the choice between mercury manometer systems and bellows or spirals for low-pressure measurement and control; differential instruments versus float or buoyancy instruments for liquid level; the need for reset action or rate action on various control applications, and the value of integrated or cascade control systems. None of these problems has a simple all-inclusive answer, but a sound background of up-to-date field experience will help the Design Engineer to make the correct choice. *The criterion of correct instrument design is field performance.*

In order that the Design Engineer and the Field Engineer may get the utmost benefit from start-up experiences, there must be complete cooperation between the two. The Design Engineer should be prepared to explain the reasons for his choice of instruments or control types and, if necessary, admit his errors. At the same time he should insist on a fair trial for any installaiton which he feels has been unjustly condemned. The Field Engineer must be willing and able to demonstrate his likes and dislikes for certain instruments, and to give positive reasons for condemning any installation.

Conclusion

In summing up, the author feels that some of the major lessons to be learned from the start-ups are:

1. The necessity of taking nothing for granted concerning the installation or operability of the instruments.
2. The importance of giving the instrument crew the training and information they need to do their job competently.
3. The value of start-up participation to the Design Engineer.

On a modern process unit, the behavior of the instruments can make or break a start-up—and the highest praise that can be given the instrument crew is: "The instruments gave no trouble at all."

Control *of* Product Quality *by* Plant-type Infrared Analyzers

By GEORGE A. MARTIN, Standard Oil Development Co., Elizabeth, N. J.

Introduction

THIS article deals with the present status of non-dispersion type infrared analyzers applied directly to the streams of operating units. About three years ago this type of gas analyzer was introduced and successful applications directly on plant streams have now been made. The physical principles and basic phenomena upon which these analyzers work, together with their possibilities and limitations, will be discussed. No attempt will be made to delve into the intricate mathematics involved in the development of this technique.

Product Quality Control

This subject should be of particular importance to operating personnel because market demand for purer products is growing and the time may soon come when certain products of inferior grade cannot be sold except at a loss. For instance, assume a plant designed to make product "X" of 98 percent purity at a rate of 1000 gallons per hour. Operation is not difficult at this rate and product purity is between 98 and 99 percent half of the time and between 97 and 98 percent the other half. The total product, with an average purity of 98 percent is marketable. This is profitable until the market demands 99 or maybe 99.5 percent purity; and 98 percent product is no longer marketable. This is not just an academic situation; it happens in industry.

In such a situation, conventional methods of running units by temperature-pressure relationships as a guide and relying on spot samples and/or composite samples being taken to the laboratory for analysis are no longer adequate unless plant design and operation are drastically changed. This is because with increased purity required, the unit can barely make specification product under ideal conditions and, unless throughput is cut drastically, considerable rerunning will be necessary. Under the new conditions plant capacity may be cut 50 percent to 500 gallons per hour of 99 percent product. Therefore, an instrument to analyze the product continuously will make it possible to increase production by reducing the risk of producing substandard product.

Another example is the case where a plant is designed to produce as much product as possible by removing all of a certain component in a complex stream. The amount of this component in the feed stream varies. To run the plant in such a way to be sure of removing all of this component may be inefficient as far as other chemicals and utilities are concerned. However, in cutting back to improve efficiency in this respect, some of the desired material may be lost to waste, thus reducing product. The optimum operating conditions cannot be determined by the usual methods of temperature and pressure control as these have little bearing on the separation. Therefore, analyzing the feed or waste stream for the desired component affords an excellent method of control to maintain maximum plant efficiency.

Analyses can be obtained by various methods. For instance, a mass spectrometer can, in a short time after a sample is sent to the laboratory, furnish accurate measurement of all its components, or an infrared spectrophotometer can be used for analyzing these samples for certain components. However, these instruments require skilled operators and the length of time between sample procurement and analysis results may be hours. This is much too long to be considered for direct product quality control.

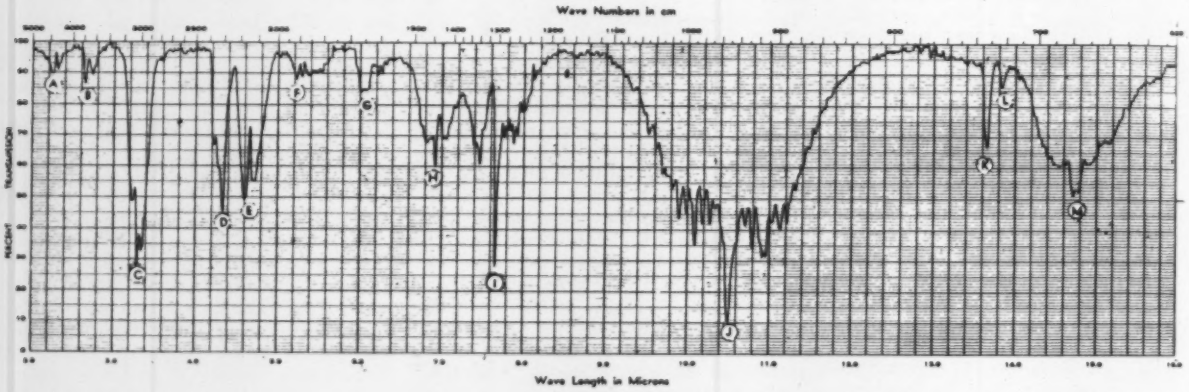

Fig. 1. Infrared spectrogram of illuminating gas.

Carbon dioxide	B D K L M	Ethylene	A C F G H J
Carbon monoxide	A E	Methane	A C I

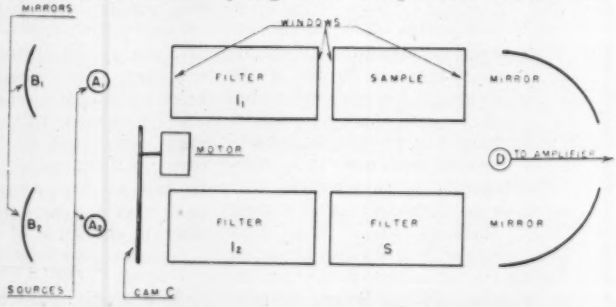

Fig. 2. Schematic diagram of infrared analyzer.

Discussion

Infrared Spectrophotometers

In the spectrophotometer the radiation is dispersed by a prism and the record shows the percent of the individual bands transmitted through the sample. The chart is then

* Presented at Short Course on "Instrumentation for the Process Industries," Texas A & M College, Oct. 12-14, 1949.

analyzed by a technician and the results tabulated. Fig. 1 is a typical spectrogram showing the particular bands transmitted by various components. After the sample is put into the instrument the recording is made in 12 minutes. The non-dispersion-type infrared analyzer differs from the spectrophotometer exactly as its name implies. The beams of radiant energy are not dispersed as in the spectrophotometer. Therefore, all of the bands of radiation useful in the analysis are acting at one time.

Non-dispersion Infrared Analyzers

The spectrophotometer has much greater value in a laboratory than the non-dispersion type instrument. However, in analyzing a plant stream continuously for a particular component the non-dispersion type competes successfully. The prime requisites for instruments in plant stream service are:

1. High speed of response to a change.
2. Ability to reproduce results from day to day.
3. Simplicity of components and assembly.
4. Low maintenance requirements.
5. High accuracy.
6. Low cost.

The non-dispersion-type instrument meets all of these requirements admirably. It produces a continuous record of the percent of the specific component for which it is sensitized. The time constant of the instrument is essentially that of the recorder proper. Therefore, the over-all speed of response of the application is a function of the capacity of the sampling system, from the sampling point through the sample cell, the flow rate of the sample through this system, plus the speed of response of the particular recorder employed. With proper engineering of the sample system, the over-all speed of response can be reduced to seconds. This means that if a change in product composition occurs, the operator will know it in less than a minute.

The instruments of this type which are produced commercially are divided into two groups.

One group utilizes "chopped" radiation which produces a pulsing or alternating signal in the detector. Fig. 2 shows a schematic diagram of an instrument of this group.

The radiant energy from sources A_1 and A_2 is reflected by mirrors B_1 and B_2 and alternately interrupted or "chopped" by the motor-driven cam C. The alternating pulses pass through the filters I_1 and I_2, the sensitizing filters S, and the sample cell. The pulsing beams are concentrated by mirrors onto the detector. As the beams are pulsing out of phase with one another, the resultant is an alternating signal with a frequency equal to the speed of the chopping cam. This signal is amplified and recorded. It is thought by many engineers that the a-c. amplifier makes this type of instrument more stable than the steady-state type.

Chopped beam instruments were apparently quite widely used in Germany during the past ten years for analyzing gaseous streams for CO and CO_2.

The steady-state-type instrument which is most commonly used today usually has a single source of energy consisting of a small coil of electrically-heated wire. The rays from this hot wire are split into two beams. Fig. 3 illustrates the arrangement of such an instrument. In this instrument the radiation is reflected by two mirrors which collimate the rays before they pass through the cell assembly. In this assembly four cells are shown, namely: sample, filter, compensator, and interference. The detector is a bolometer or a resistance bridge wherein a change in radiation falling on one side of the bridge with respect to that on the other will cause a relative change in the respective resistances, thus unbalancing the bridge. This degree of unbalance is amplified and recorded. This unbalancing is commonly spoken of as resistance transfer and is used as a designation of the sensitivity of the instrument.

Fig. 4 illustrates another design of steady-state type instrument. In this instrument the cell arrangement is different although four cells are used. The source is not split or collimated before passing through the sample and interference cells. The filter cells are built into a divided cone which serves to split the beam and funnel the rays onto the detector. T_1 and T_2 of Fig. 4 are the junctions of a thermopile; thus, as more radiation falls on one or the other of the multiple junctions the net emf, output will change. The signal is, of course, steady (not pulsing) and after amplification is recorded. In this instrument the voltage output of the thermopile is the measure of sensitivity of the instrument.

Operation

The fundamental phenomenon on which these instruments operate is that many gases absorb infrared rays in varying amounts, depending on the wave-length of the radiation. Fig. 5 is an example of plots of such data or "spectra." The amount of radiation absorbed by ethylene, ethane, and methane at the various wave-lengths from 2.0 to 8.0 microns is shown as one spectrogram.

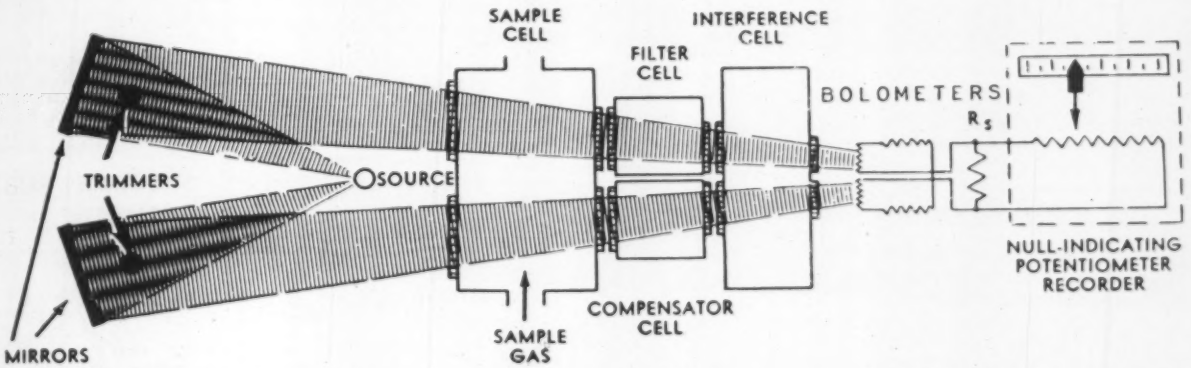

Fig. 3. Optical diagram of four-cell control element for Baird Associates recording infrared analyzer.

Not all gases absorb in the infrared region, however. Some, among which are oxygen, nitrogen, and hydrogen, do not absorb infrared radiation. Thus, if it is desired to analyze for a particular compound such as CO (which is a heavy absorber) in the presence of nitrogen and oxygen, it is necessary merely to introduce pure CO in one beam of the analyzer while the sample of the unknown gas is passed through the sample cell, which would be in the other beam. Under these conditions, all of the infrared rays which are absorbed by CO are blacked out of one beam. Therefore, this side of the detector would be cooler than the other when anything below 100 percent CO is in the sample cell. Thus, the cooling effect on the detector of the filtering CO in the one beam causes a change in the signal of the detector. For this simple analysis, an analyzer having a sample cell in one beam and a filter cell in the other beam would be sufficient.

For more complicated analyses, such as one hydrocarbon in the presence of other hydrocarbons all of which are absorbers, a more complex cell assembly is necessary. An example is the measurement of ethylene in the presence of other hydrocarbons, such as methane and ethane with traces of propylene, CO_2 and CO. It is necessary that all of the bands of infrared radiation which are absorbed by these background gases be prevented from falling on the detector in varying amount. A simple way to do this is to

remove them from the beams completely. Therefore, in this application, the filter cell (refer to Fig. 3) would be filled with pure ethylene, as this is the component for which the instrument is to be sensitized, and the interference cell placed across both beams is filled with the background gases in the proper proportions. In the event that some of the bands are common to a background gas and to ethylene, this particular background gas would be put into the compensator cell in the beam opposite the filter cell. The amount of gas put into the compensating cell is determined by the degree of sensitivity required and the completeness with which background interference must be eliminated. In practice, these gases are put into the cells under pressure of one atmosphere absolute. In the event that less gas would be desirable in the compensator cell, the compensating gas is mixed with a non-absorbing gas such as nitrogen. This is done so that no differential pressure exists between the atmosphere and the inside of the cell except that resulting from barometric pressure changes.

In sensitizing an instrument in this way, it will be seen that a considerable quantity of the original source energy is absorbed in the sample, interference, compensating, and filter cells. As the amount of energy used for sensitizing is increased, the amount available for signal strength decreases, and therefore the sensitivity required in the recording system increases. For instance, in analyzing a simple gas mixture, such as CO in air, as much as 50 percent of the source energy may be available for signal output; whereas in the ethylene anaylsis described, 95 percent of the energy of the source may be required for sensitizing the instrument, leaving only 5 percent available for signal.

Classification

Infrared instruments may be classified relative to sensitivity about as follows:

(1) Where 20 to 50 percent of the source energy is available for signal strength, the instrument would be classified as having low sensitivity. This classification covers application such as: CO in the atmosphere of vehicular tunnels, CO_2 in the air in agricultural experimental stations, CO in catalytic cracking plant flue gas.

(2) Where 5 to 20 percent of the source energy is available for signal strength, the instrument would be classified as having medium sensitivity. This classification covers applications such as: ethylene in other hydrocarbons; C_4 hydrocarbons in C_3 hydrocarbons; propylene in propane plus lighter fractions; butyl alcohol in methyl ethyl ketone.

(3) Where 0.5 to 5.0 percent of the source energy is available for signal strength, the instrument would be a high-sensitivity instrument. This classification covers applications such as: isobutane in normal butane and isobutylene; isobutene in isobutane, normal butane and normal butenes; moisture in low concentrations in hydrocarbon streams.

Applications under consideration in the oil refineries indicate that a considerable portion will fall in the high-sensitivity range, perhaps one third of them. As the sensitivity requirements of the instrument go up, or as the amount of energy available for signal strength goes down, the degree of electrical amplification must go up if plant recorders are to be used. This electrical amplification can be carried only to the point where the "noise" level of the electric circuits begins to be an appreciable portion of the signal received. Otherwise, the "noise" or random variations would begin to look like sudden changes in plant operation.

Instruments delivered by manufacturers for commercial applications have been of low and medium sensitivity so far, although some high-sensitivity instruments are currently in production. These instruments are all designed to handle fluids in the gaseous state. In this connection it is noted that the need for an analyzer to handle liquid samples is becoming more pressing. It is anticipated that for these liquid sample analyses still higher sensitivities may be required.

Application Experience

The difficulties experienced with commercial instruments are outlined as follows, in the order of their magnitude:

(1) The sample system must be continuously reliable. A clean sample must be brought to the analyzer without the possibility of scale, gum or other foreign matter being deposited within the sample cell. Any deposit on the windows of the sample cell will decrease the amount of energy transmitted. In the event that the cell windows are made of sodium chloride, moisture in the sample cell will cause fogging of the windows and eventually a reduction in energy transmission. There are some indications that sulphur compounds in the sample, especially aqueous sul-

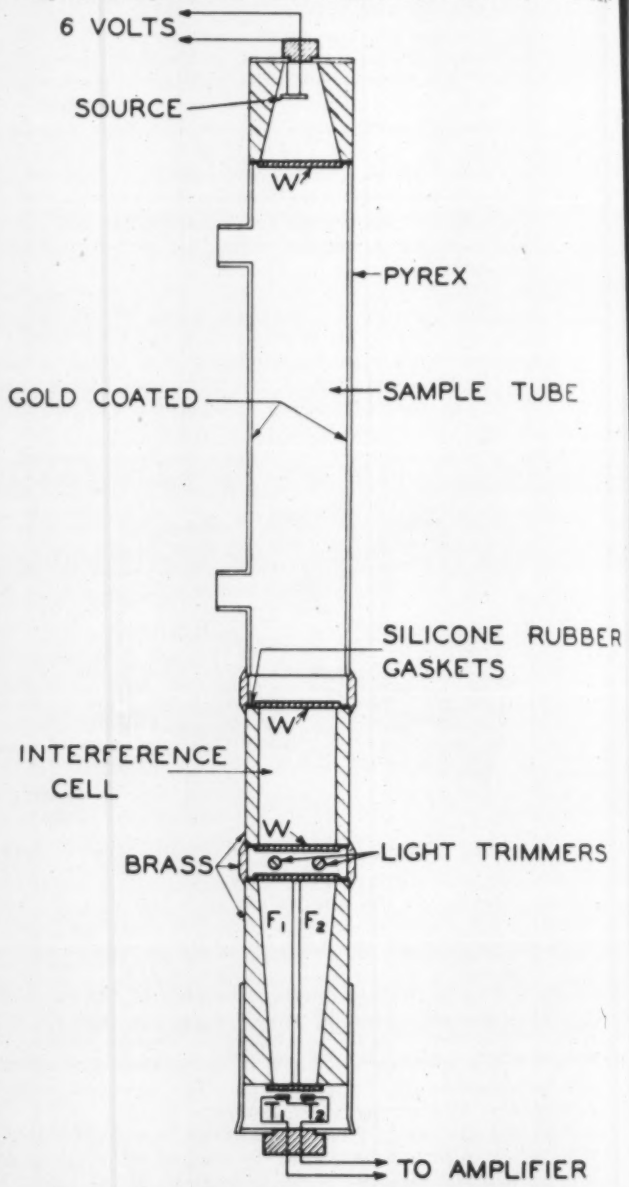

Fig. 4. Leeds & Northrup infrared analyzer.

phur compounds, will cause discolorations when silver nitrate windows are used, thus reducing transmission. Calcium fluoride windows can be used for some applications. These are not affected by moisture or sulphur. However, the transmission constant of this material is inferior to that of the other two and the cost is many times higher. It therefore appears that the sample must be thoroughly cleaned and dried. Good results have been experienced when these precautions have been taken. Conversely, maintenance has been high where foreign matter and moisture was present.

(2) In applying these instruments to plant streams, the necessity for securing accurately blended gases for sensitizing and calibration becomes a major problem. These gases can be purchased blended to what might be considered fairly close tolerances; plus or minus 1 percent of the various components. However, when sensitizing instru-

ments of this nature, it is necessary to know the amount of gases present to within one tenth of 1 percent. This information can only be secured from a laboratory where extremely sensitive instruments are available, such as the National Bureau of Standards or large industrial laboratories. The manufacturers of the instruments do not have the facilities for blending or analyzing gases to these tolerances. It is felt that as more and more demand for this type of material becomes apparent to the blended gas vendors, some facilities will be made available so that instrument manufacturers will be able to purchase accurately-analyzed gas or liquid blends.

(3) In applying instruments of this nature to plant streams, the analyzer where the hot infrared radiation source is located and the control house where the recorder is located are usually some distance apart. In the commercially-available instruments, the voltage impressed upon the hot-wire source must be controlled to extremely close limits. The temperature level of the source must be constant. Therefore, the resistance of the conductor from the source to its voltage regulator must be constant regard-

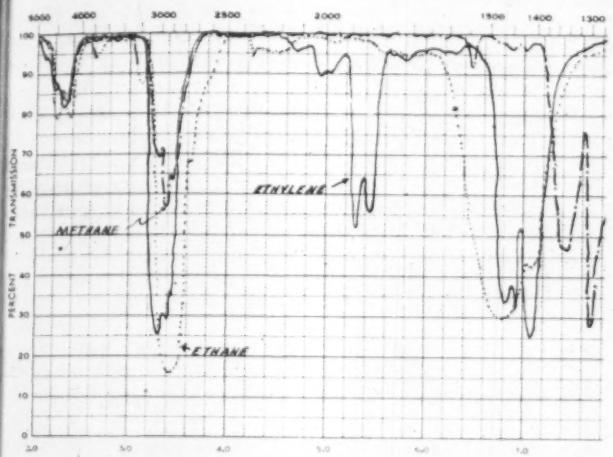

Fig. 5. Absorption of ethylene, ethane and methane in region from 2 to 8 microns.

less of the distance between the two and regardless of ambient temperature changes. When the voltage regulator and transformer are at the same location as the source, no difficulty is expected. However, when the instrument has been designed for use in Class 1, Group D hazardous locations and the analyzer is mounted on the structure, the voltage regulator may be mounted in a control house where explosion-proofing is not required. This remote mounting of the voltage regulator necessitates an increase in the size of the conductor to the source in order to assure full voltage at the analyzer. It will readily be seen why this is necessary when it is pointed out that the radiation or emission of the source varies as the fourth power of the absolute temperature. Therefore, any decrease in source voltage would result in a decrease in current and source temperature and in a considerable decrease in radiation. This may not be significant in the low-sensitivity applications where ample energy remains for signal; however, in the medium and high-sensitivity applications, this can be serious.

In general, instruments for plant application must be simple and easily understood by the maintenance division; and must require a minimum of time for maintenance. Massive parts, such as are used in present mass spectrometers, are difficult to maintain in the plants, especially if they are to be moved to the shop for sevrice. In this respect the infrared instruments lend themselves readily to plant application. The parts are small and may be easily removed for service. The electronic components are relatively simple and can be maintained by anyone familiar with radio circuits.

Laboratory instruments, in general, are standardized by the technician every time an analysis is made. In the plant this is not feasible; nor is it recommended that standardizing be made automatic unless it can be accomplished entirely electrically. The idea of automatically passing a standard gas through the sample cell is frowned upon because it is impossible to foretell when the automatic change-over valves will begin to leak and thus contaminate the standardizing gas which is being passed into the sample cell. Should this happen, the instrument would restandardize itself on a non-standard sample and go on its way giving erroneous results until a true standard sample was passed through the cell. In order to obviate the need for automatic standardization, considerable work has been done in order to eliminate drift. It has been found that practically all of the drift in the non-dispersion steady-state-type instruments is due to ambient temperature changes. Thermostating to a fine degree is necessary and has been accomplished by using sensitive sealed mercury-in-glass thermostats operating mercury-in-glass relays which, in turn, control the power to heating elements composed of electric-light bulbs. Incandescent bulbs are used because the energy output is immediate and the heat capacity is extremely low. For instance, experience shows that such thermostats operate off one second and on one second under some conditions. The over-all temperature level of the instrument is not critical. It may be 120 or 150 F. as long as it is constant. Temperature gradients between one portion of the analyzer and another, especially around the bolometer or thermopile, cannot be tolerated. In the medium and high sensitivity instruments, a differential temperature of 0.001 F. from one side of the bolometer to the other will cause a drift of about one percent of the range of the instrument. In order to minimize gradients, circulating fans are used, operating continuously.

Excellent thermostating has been achieved in one design by employing two blowers, one at each end of the large explosion-proof case which surrounds the analyzer-cell assembly. The explosion-proof case which is aluminum is surrounded by about three inches of glass-wool insulation inside a steel case. With this insulation it has been found necessary to use a thermostat set at 150 F. Thermostats set at 120 F. were originally installed in one application and it was found that when the ambient temperature exceeded 90 F., the recorded signal would drift with the ambient temperature. Data are available to show that with a 150 F. thermostat, drift does not occur until ambient temperature exceeds 120 F.

With the thermostat maintaining proper temperature, it has been shown that drift on a medium-sensitivity instrument over periods of days is not sufficient to warrant automatic standardization. Assuming that the interference, compensator, and filter cells do not leak and the temperature of the assembly is constant, the only cause for drift would be the aging of the source or of the detector. It is fairly well established that drift due to these causes is very slow and that manual standardization once a week or once a month should be sufficient to correct this type of drift. It is therefore felt that automatic standardization is detrimental to the advancement of this technique and that manufacturers should design instruments sufficiently stable to make this unnecessary.

Conclusion

In conclusion, it is believed necessary for the purchasers of plant type instruments to insist that manufacturers produce instruments designed for plant application and not accept laboratory-type equipment which has been somewhat modified in the hope that it can be applied in the plant. These "hashed-up" laboratory-type instruments, in general, will require more maintenance than was ever contemplated from experience in the laboratories, when they are subject to the relatively rough handling in the plants. If all customers of this type of equipment insist upon ruggedly-constructed well-mounted parts and electronic equipment, the manufacturers will make quicker progress along this line.

The non-dispersion-type infrared analyzers can produce and are producing reliable records of a single component in a complex mixture to an accuracy which is difficult to duplicate even with an expensive mass spectrometer. The field of application for these instruments is much broader than is generally known. As information relative to the usefulness of this plant control equipment is more widely disseminated, the field will increase in size.

Time-constant Selection *in the* Application *of* *RC* Differentiating *and* Integrating Circuits

By ROBERT J. JEFFRIES, Research Associate, Dep't of Engineering Research,
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Introduction

SIMPLE series combinations of resistance and capacitance, used as differentiating and integrating circuits, are well-known and widely applied in various forms of vibration-analysis equipment. Proper application of these equipments calls for judicious selection of a circuit time-constant from those available. This selection is determined by the nature of the signal to be differentiated or integrated, and by the circuit configurations and components available. Injudicious selection of the time-constant will result in erroneous output signals.

RC Circuit Performance and Selection Criteria

The basic form of an *RC* differentiating or integrating circuit is shown in Fig. 1. The signal voltage which is to be either differentiated or integrated is applied across terminals A and E. If differentiation is desired, the output voltage is taken from terminals B and C when Xc is much greater than R; if integration is desired, the output voltage is taken from terminals C and D when R is much greater than Xc.

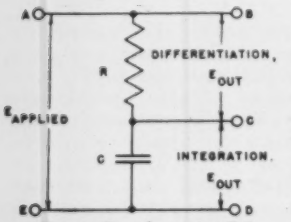


Fig. 1. Simple series-*RC* differentiating and integrating circuit.

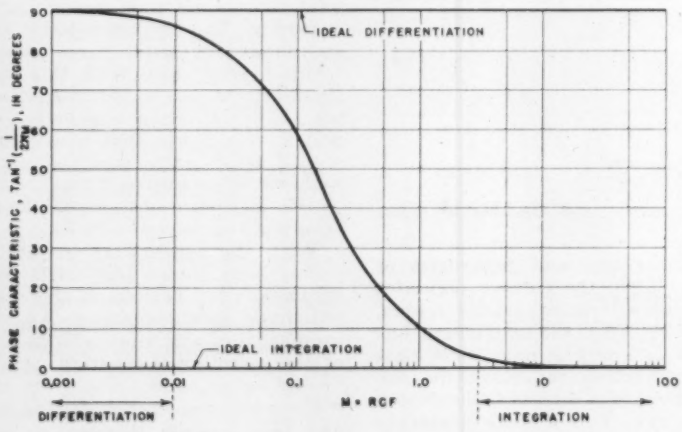


Fig. 2. Time constant selection curve for a simple series-*RC* differentiating or integrating circuit.

The performance of the circuit for both operations may be presented in graphical form in terms of a parameter M, which is defined to be the product RCF. In this definition, R is in ohms, C in farads and F in cycles per second. The performance is characterized by the phase response of the circuit since a selection of time constant based on this curve yields more accurate results than those obtained with the aid of an amplitude response curve.

Fig. 2 illustrates the behavior of the circuit when used to effect differentiation and integration respectively. The ordinate represents a quantity by which the phase angle of the output voltage may be compared visually with the ideal angle corresponding to the operation performed. The useful operating ranges of the circuit are limited to the horizontal portions of the graph. For differentiation, this useful range occurs for values of M less than approximately 0.01; for integration, this range occurs for values of M greater than approximately 3.0.

Since $M = RCF$, it is obvious that for every signal frequency applied which is to be either differentiated or integrated there is an upper and lower limit, respectively, to the usable time constants.

The use of Fig. 2 is illustrated by two examples.

Example 1: Assume that a signal of 10 cps. is to be differentiated. From Fig. 2, M must be less than 0.01, and hence RC must be less than 0.001. The particular RC chosen under the conditions specified is unimportant and would probably be dictated in practice by the values available to the user of the equipment. If, however, the applied signal also contained harmonics of the 10-cps. component, or any other higher-order frequencies of significant amplitude (and this is the usual case) then the highest frequency component to be differentiated would have to be considered in the determination of the time constant from the acceptable values of M.

Example 2: If a signal of 10 cps. is to be integrated, Fig. 2 indicates that M must be greater than 3, and hence the time constant must be greater than 0.3. For reasons analogous to those of Example 1, when any signal consisting of multiple-frequency components is to be integrated, the value of time constant used must correspond to a value of M greater than 3 for the lowest frequency component to be considered.

In the application of commercial equipments the specific value of M used is limited to those provided. In the design of circuits of this type, the values of the time constant and the apportionment between R and C are limited by considerations of size and characteristics of circuit components available.

The effect of incorrect choice of time constant is illustrated by Fig. 3. Fig. 3(A) illustrates one cycle of an arbitrary periodic applied function containing a fundamental frequency and a second harmonic component equal to the fundamental in amplitude. Fig. 3(B) illustrates the corresponding steady-state output waveforms obtained from a simple *RC*-series integrating circuit when $M = 0.6$ and $M = 3.0$, superposed on a waveform representing the true integral.*

The resultant waveform for $M = 3.0$ (minimum acceptable value) is seen to coincide, within the limits of the scales used, with the function representing the true integral, while the output function corresponding to $M = 0.6$ (an unacceptable value) is seen to be in considerable error.

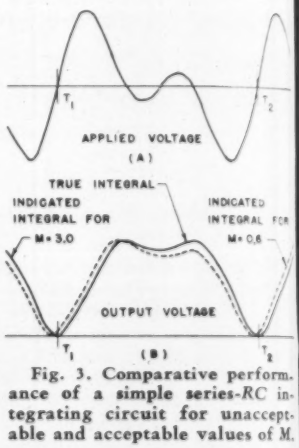


Fig. 3. Comparative performance of a simple series-*RC* integrating circuit for unacceptable and acceptable values of M.

Table 1 presents a tabulation of usable time constants for various significant signal frequencies to be differentiated or integrated.

Table I—Desirable Time-constants

A (cps)	B (seconds)	C (seconds)
1	0.01	3
10	0.001	0.3
100	0.0001	0.03
1000	0.00001	0.003
10000	0.000001	0.0003

A. Significant frequency component (highest for differentiation, lowest for integration).

B. Maximum usable time-constant for differentiation.

C. Minimum usable time-constant for integration.

Acknowledgement: The author wishes to express his appreciation to Mr. E. H. Tompkins, Graduate Student in Electrical Engineering, for his assistance with the illustrations.

*To facilitate this comparison and to present all waveforms on a comparable basis, the instantaneous values of the function corresponding to $M = 0.6$ have been multiplied by RC and the instantaneous values corresponding to $M = 5 \times 0.6 = 3.0$ have been multiplied by $5 \times RC$.

Some Application Factors Affecting *the* Regulation *of* pH *in* Industry

By ALLEN L. CHAPLIN, Consulting Engineer

VII. THE pH REGULATOR

The advancement of pH control equipment has followed an interesting development which originated with simple two-position regulators and progressed through multiple-position controllers to proportional-position regulators and our present derivative and proportional-speed floating controllers, to the most effective technique of cascaded regulators. The majority of existing installations are probably of the proportional-position type. No single regulator is better adaptable generally to all types of processes than another: different processes have different reaction rates; and some are designed according to control requirements, while others are fixed, and regulators must be selected and applied to obtain the best regulation commensurable with process limitations.

Should one base his selection of equipment purely on the basis of theoretical derivations and ignore all limiting factors of process operations, and should he regard all reactions as instantaneous and devoid of equilibrium lag, he would find many advantages to derive from control in a zero-capacity system wherein reagent and process liquor are brought together in molecular films. If a process could be designed without limitations, and equipment sized according to ideal calculations, the total inventory of direct high-rate neutralization reactions could be reduced and daily throughput per dollar cost of equipment would increase.

This is an ideal condition with only theoretical foundations but it does represent the limiting condition of certain trends in some proces design. Regulators for such "ideal" processes could have no dead time or lagging response and their reaction constant would have to be much lower than, or at least equal to, the process reaction constant.

Practical aspects of instrumentation bear heavily upon the limitations of this ideality for the present at least, but trends may dictate lower inventory units in some cases and pH regulators should not be a limitation. In at least one case, a proportional-speed floating regulator has been applied with a minimum of external stabilization to regulate pH in a low-residence direct high-rate neutralization reaction and it might be expected that further refinement of this type regulator, or similar equipment should extend the present limitations of conventional methods.

* * *

In many cases it has been necessary to apply control to an existing process having a higher time constant than would normally have been introduced had it been designed in keeping with control requirements. In some cases this condition is overcome by use of cascaded regulators while in others a single proportional-position regulator having a proportional band of 1000 to 3000 percent or more has been applied. There is somewhat of a paradox to the latter practice since proportional-band settings of such magnitude render the primary proportional action insensitive to any but large load swings, and the process may be dependent upon its own residence and the floating action of the regulator to compensate for normal load swings. The question naturally arises as to whether the greater advantage would derive from cascaded regulators or from a single proportional-position regulator for the process in question. In many instances of the writer's experience it has been possible to remove the proportional action entirely when proportional band settings approaching 1000 percent were required, and obtain equally satisfactory control from reset action alone which had been changed from its normal rate. Again the question arises, "would not a simple floating regulator have done the job?"

In another case, a proportional position regulator was applied to a process having low residence and high reaction rate and, to obtain any acceptable degree of regulation, the proportional band was increased to 1000 percent to desensitize proportional action and further widened effectively by reducing valve linkage to throttle its angular travel. Furthermore, reagent acid was diluted to more effectively widen the proportional band, thus necessitating installation of additional process equipment. Replacement of this regulator by a proportional-speed floating regulator cascaded with a proportional-reset regulator (which stabilized the first) permitted use of more concentrated reagent and produced a more satisfactory control record. Under such circumstances, the process control engineer should analyze the process from an engineering standpoint and determine whether it is to his advantage to use proportional-speed floating control or a proportional-position regulator, or whether derivative action or any other mode of regulation would be more effective and economical.

The best results have been obtained by the writer from proportional-position regulators when applied to processes of moderate residence and low buffer index. When cascaded with other regulators such as flow, etc., they offer superior advantages, in some cases not obtainable from a single regulator. Probably the outstanding advantage of a proportional-position regulator is its relative flexibility and applicability to a wide variety of processes with or without self-regulation characteristics. It is the most universal regulator for general pH applications and has been applicable, by modification, to a wide variety of problems. Air-operated regulators have been preferred in many cases because of faster valve action while electric drives overcome disadvantages of air compressibility in large valve installations. It might also be expected that modern high-speed electronic recorders would offer advantages over older galvanometer types for rapid balancing under conditions of sharply fluctuating loads.

Some work has been reported on the modification of proportional regulators to provide variable proportional-band adjustments as a function of set-point setting or as a function of a secondary signal from a cascaded regulator. The control rate characteristic (see Fig. 1) of a given process varies at different values of measured pH and necessitates readjustment of proportional band setting with changes in set point to retain control stability. Standard regulators have been modified to incorporate a mechanism which varies the proportional band setting in accordance with a predetermined acidity characteristic when the set point is manipulated manually or automatically by a cascaded regulator. It is difficult to obtain exact compensation over the entire range of control rate characteristic, but good compensation has been obtained over limited ranges.

When a cascaded pH regulator resets the index of another regulator to maintain fixed pH, it usually is not necessary to disturb proportional-band adjustments. However, under circumstances of the reverse condition, it may be desirable to provide automatic proportional-band adjustment, or its equivalent, when a cascaded regulator resets the index of a pH controller. An inspection of the acidity characteristic will give a fairly reliable prediction of whether resetting is necessary over the pH load range anticipated. If the curve is flat and gentle and the buffer index low, it may not be necessary to incorporate the feature of automatic adjustment: The necessity for this feature must be determined by analysis of individual applications.

VIII. A GRAPHICAL DETERMINATION OF APPROXIMATE THROTTLING-RANGE ADJUSTMENTS.

In many cases it would be desirable to derive an approximately correct guide for setting of proportional-band adjustment during initial start-ups to avoid undue disturbances to the process when the regulator is switched from manual to automatic control. Excessive cycling may result in damaged or reject product or may inject disturbances

Continued on page 1138

The Month's NEW INSTRUMENTS

In this department we report each month new devices for measurement, inspection, testing, metering and automatic control — in the form of concise technical descriptions.

FOR FURTHER INFORMATION USE THE POSTAGE-FREE ORDER CARD ON PAGE 1167

Single-phase Watthour Meters

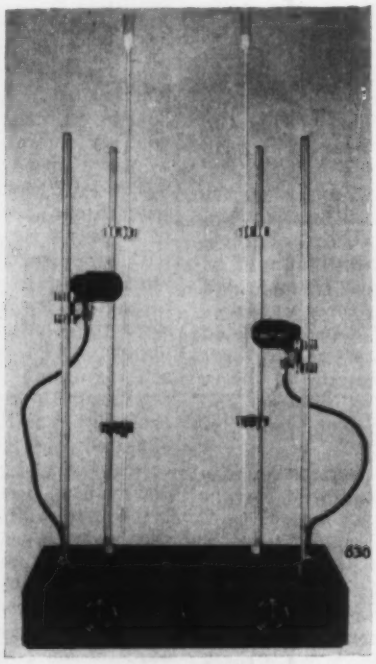
New "Type S-3" socket-type watthour meter employs unit construction of all four major assemblies: base, electromagnet, damping system and register. Current and potential coils can be quickly and easily replaced with coils of other ratings. Meter is available in 2- or 3-wire single-phase 5- or 15-amp. rating for 120- or 240-volt

service. Other features: Base—one-piece crack, warp-, and break-proof steel with "Melamine" insulation and wool felt gasketing. Electromagnet - Overload compensation to 400 percent of rated load; layer-wound vacuum-impregnated potential coil; separable current and potential coil laminations replaceable. One-piece back plate supports damping system, aluminum-alloy disk supported on selected alloy steel ball bearing between sapphire jewels, magnets silver-plated to provide shielding against lighting surges, light and full load adjustments from front of meter. Dial or cyclometer-type registers are interchangeable. Standard cover has clear flint glass viewing surface, sealing ring compresses resilient non-corroding gasket of "Corprene" against meter base. Bonderized zinc, cadmium, albaloy and lacquer finishes on structural parts insure reliable operation under severe service conditions.—*Roller-Smith, Bethlehem, Penna.*

Mention No. 1201 when filling out card.

Ultraviolet Chromatographic Analyzer

New "U-Ve-Chrom" analyzer utilizes a combination of ultraviolet stimulated fluorescence and selective adsorption on silica gel, as now being used in the petroleum industry, to determine aromatics in hydrocarbon solutions. Several simultaneous determinations can be made by a single operator. Power supply, mounted under base, is designed for continuous operation on 110 v. 60 cps. Twin ultraviolet light sources, of mercury arc type, are independently adjustable by means of a rheostat. Ultraviolet radiation peaks at 3650 A; filters remove all but a trace of violet visible light. No

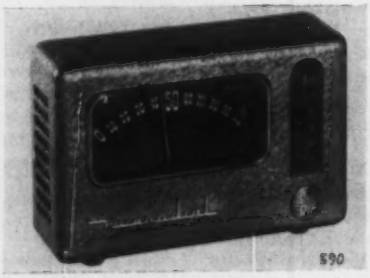


eye protection of any kind is required. Each instrument is supplied with two Pyrex adsorption tubes 4 mm. in diameter and 760 mm. overall, having an enlarged section at one end 50 mm. long, for ease in filling.—*Phillips Scientific Specialties Co., Cranford, N. J.*

Mention No. 1202 when filling out card.

Temperature and Humidity Indicator

New "Model 185 Hygrodial" for wall or desk mounting has an effective range of 0 to 110 F., and 10 to 95 percent R.H. Thermometer is liquid-in-

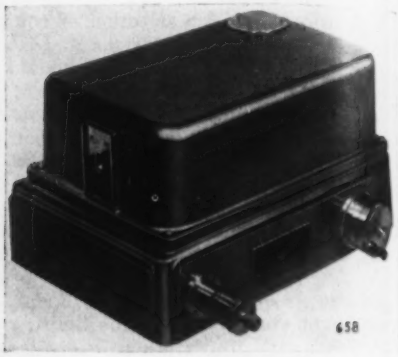


glass; and hygrometer uses multiple-human-hair element.—*Friez Instrument Div., Bendix Aviation Corp., Taylor Ave. at Loch Raven Blvd., Baltimore 4, Md.*

Mention No. 1203 when filling out card.

Universal Monochromator

New "Model 83" monochromator consists essentially of maker's present "Model 12" infrared spectrometer optics from entrance slit to exit slit, with wavelength and slit controls under a standard cover but on a new base assembly. Optics are totally reflecting so that instrument can be focused with visible light for use in ultraviolet or infrared from 0.18 to 40 microns. Col-

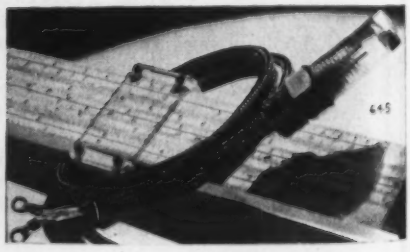


limator is an 18-degree off-axis parabola of 270-mm. focal length, and effective aperture of Littrow mount is f 4.5. Prisms available are fused quartz, crystal quartz, glass, LiF, CaF_2, NaCl, KBr or KRS-5. A 14-degree parabola can be supplied. 15,000 and 7,200 lines per in. replica gratings are available. Slits are bilateral with entrance slit curvature of 5.59 in. and are adjustable to 0.5 micron. Accessories such as cell mounts, special covers, and a mirror assembly which permits beam from exit slit to be deflected at right angles or allowed to pass out of special cover, are available.—*Perkin-Elmer Corp., Glenbrook, Conn.*

Mention No. 1204 when filling out card.

Resistance-thermometer Bulb for Telemetering

New "Type 17-2 Air and Gas Temperature Telemetering Pick-up" is a platinum resistance thermometer for temperature range 0-600 F. (0-315 C). When inserted in air moving at 5 fps., its thermal time constant is less than 0.5 second. Balancing bridges are available to provide zero output at 0 C. and 5 mv. per volt applied at 600 F. Other



ranges are available. New unit is said to be sufficiently fast to record inhale-exhale temperature of human breath.—*Trans-Sonics, Inc., Bedford Airport, Bedford, Mass.*

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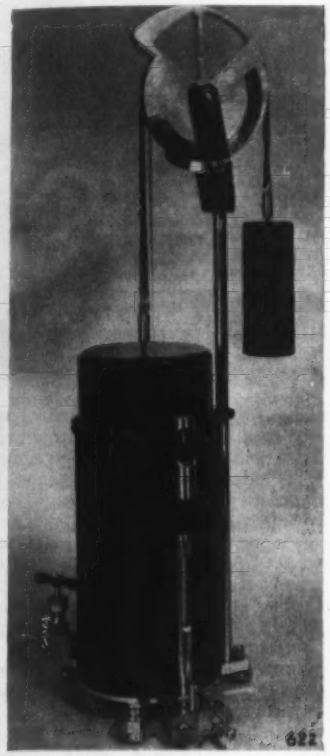
Precision Gasometer

New "Gulf Type" gasometer has a capacity of 0.1500 cu. ft. readable to 0.0001 cu. ft. with abs. accuracy of

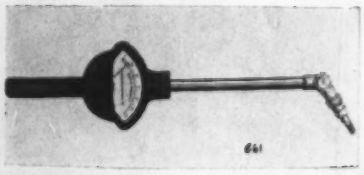


approx. 0.0003 cu. ft. Calibration in cc. is available (readable to 5 cc.). Use of mercury as sealing fluid obviates need of vapor pressure corrections and prevents loss of gas.—*Coleman Instrument & Mfg. Co., 716 S. Troost, Tulsa 5, Okla.*

Mention No. 1206 when filling out card.

Surface and Immersion Pyrometer

New portable pyrometer for surface and sub-surface temperatures features a 4-in. direct-reading indicator mounted in a rubber-cushioned housing. Two models offer either a rigid ex-



tension arm or a 42 in. flexible arm with a selection of eight types of thermocouples. Each model is available in four temperature ranges from 4-400 F. to 0-1200 F., and all thermocouples may be interchanged.—*Pyrometer Instrument Co., Inc., Bergenfield, N. J.*

Mention No. 1207 when filling out card.

Refractive-index Recorder

New "Dow Robomatic Refractometer" continuously records index of refraction of flowing liquids in range 1.32539 to 1.54409 and controls over entire range within 3 parts in fifth decimal place. Instrument comprises a dipping refractometer, constant-temperature bath of range 35 to 150 F. with accuracy of 0.02 F., recorded actuated by photocell and amplifier, and an air-operated controller. It is flush-mounted on panel and may be installed any distance from process pipes. Sheet metal housing is fitted with gas-tight locking door. Over-all dimensions are 19 in. deep, 34 in. *tific Co., 3737 W. Cortland St., Chicago* 47, *Ill.*

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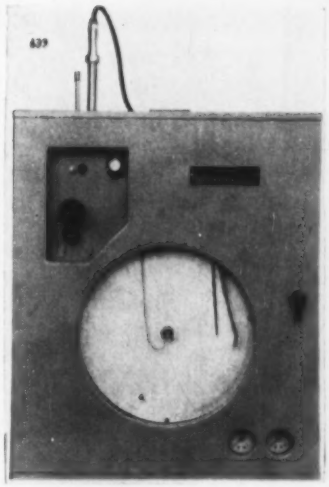
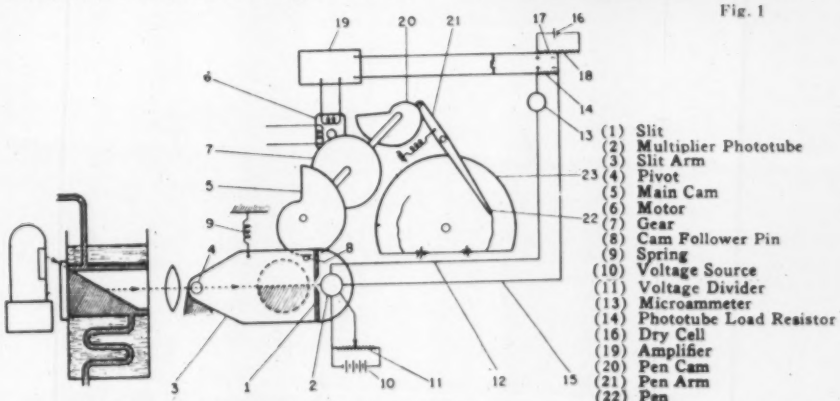


Fig. 1



639—Fig. 2. Principle of Recording Refractometer.

Coordinatograph or X-Y Recorder

New "Type 373 Rectangular Coordinate Recording System" is used primarily in determining the directional characteristics of radar antennas; can also be used to record light intensities, sound pressures, heat levels and counting rates at writing rates higher than formerly available. System measures pointing angle to better than one part in 100,000 and writes at such speed that energy being recorded can change level by 100 million to one in a quarter-second and still be faithfully recorded on inked plot. System consists of a selective amplifier, pen and paper servo-amplifiers, a power supply, and recording mechanism.—*Airborne Instruments Laboratory, 160 Old Country Road, Mineola, N. Y.*

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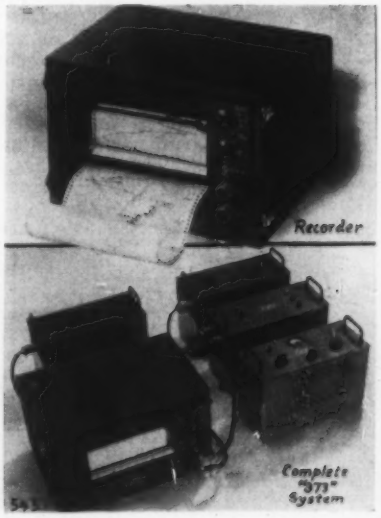
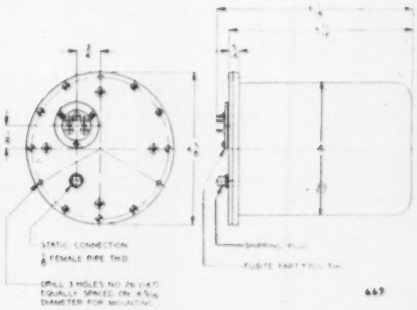


Altitude Controller

New altitude controller, an aneroid-actuated mechanism, controls automatic pilot when corrections in flight path are required to maintain a selected altitude. Instrument weighs 25 oz. and responds to as little as two feet of al-



titude change. Output in millivolts per foot can either be held constant for any altitude up to 50,000 feet, or made to drop off progressively. Adjustable stops limit output signal to values required for particular autopilot type.—*Kollsman Instrument Div., Square D Co., 80-08 45th Ave., Elmhurst, N. Y.*

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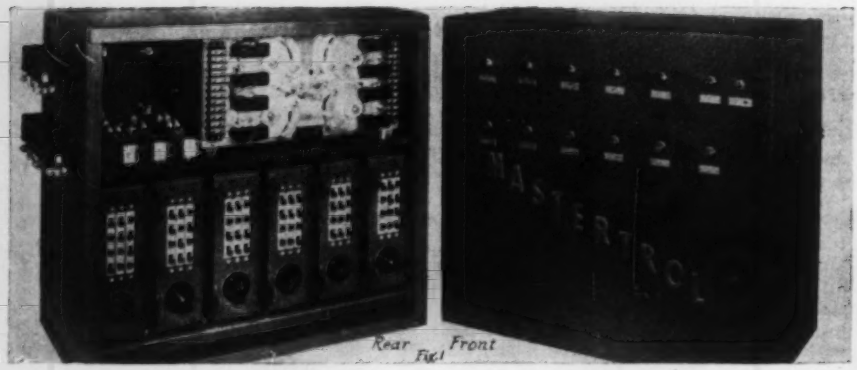

Fig. 1

Program Controller for a Battery of Machines, etc.

New "Mastertrol" combines in one cabinet one master controller and a number of individual sequence controllers each commanding one mechanical production machine or one chemical processing unit. Illustrated example is a "Mastertrol" for automatizing a battery of six rubber-goods curing presses each requiring its own cure-time, its own "bumping" schedule, etc.,

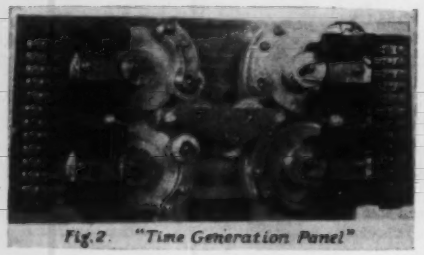
Fig. 2. "Time Generation Panel"

and none to begin its cure until operator presses its "start" push-button. Fig. 1 shows general arrangement: one shelf carries master schedule controller, known as "Time Generation Panel"; one or more shelves carry the required number of individual controllers, known as "Control Boxes," with necessary output relays. Installation wiring consists only in plugging-in cables. Supervisor alone can unlock case to adjust cures. Lights on front panel indicate a-c. supply, d-c. supply, operation of simultaneous time programs and (lower row) open or closed position of each curing press. Fig. 2 shows master controller with four separate gear trains (because in this example four cure times were required). A switch in each circuit is

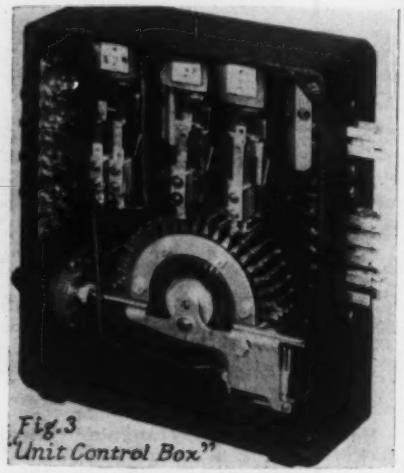
Fig. 3
"Unit Control Box"

on stand-by duty. Fig. 3 shows details of one sealed plug-in "Control Box," a standard unit with enough essential components for controlling any process unit: up to forty time "beats" comprising one cycle.—*Emmet Machine & Mfg., Inc., Akron* 14, *Ohio.*

Mention No. 1211 when filling out card.

Load and Pressure Cells

New models of maker's "SR-4" load and pressure cells extend the range of standard models on both high and low sides. Sensitive elements of these cells are "SR-4" resistance wire strain gages. In load cells, gages are bonded to a compression column. Two new load cells have 100,000- and 200,000-lb. capacity. Supplementing the load cells are load beams with which it is possible to obtain load measurements down to 2 grams full scale. Cantilever beams with capacities as high as 1000 lbs. have been built. Fluid pressure cells are available in 10-psi. capacity on low end of scale, and 100,000 and 150,000 psi. capacity on high end. In these cells, gages are bonded to outside surface.—*Testing Equipment Dep't, Baldwin Locomotive Works, Philadelphia* 42, *Pa.*

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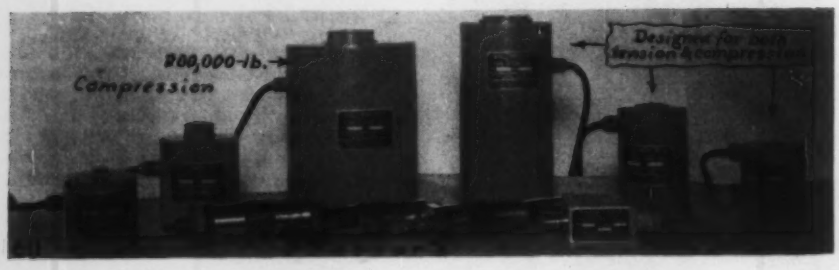
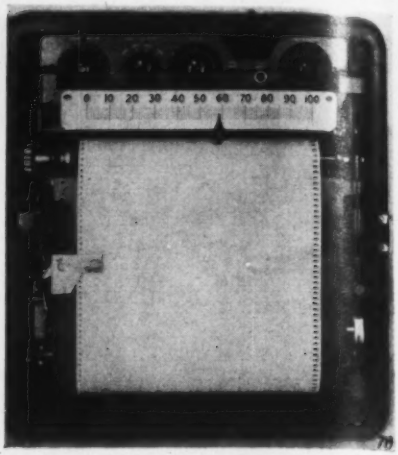


Strain Recorder

New strip-chart strain recorder for use with "SR-4" bonded resistance wire strain gages has 9.5-inch-wide chart scale, two chart speeds of 6 and 180 inches per hour, and accommodations for a two-arm and four-arm strain bridge. Slowly-varying strains can be

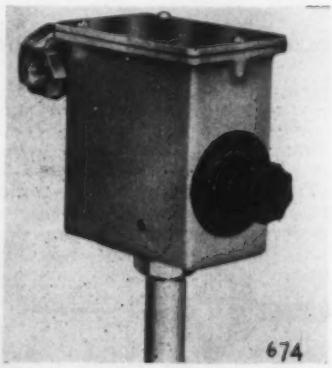


recorded for as long as 10 days without changing chart. Instrument is a special Leeds & Northrup "Speedomax" with six simple controls located over chart scale. Left to right: gage factor, strain ranges, zero adjustment, range extender, bridge voltage, and gage resistance. A d-c. power supply is built into recorder and a voltage regulator is supplied separately. Microinch ranges are 1000, 2000, 5000, and 10,000 on 6-volt bridge and 2000, 4000, 10,000 and 20,000 on 3-volt bridge. Response to full-scale unbalance is approx. 3 seconds (much shorter times for small unbalances).—*Baldwin Locomotive Works, Philadelphia* 42, *Pa.*

Mention No. 1213 when filling out card.

Temperature Controller

New "Model Y" self-contained temperature controller consists of an aluminum-cast case containing appropriate

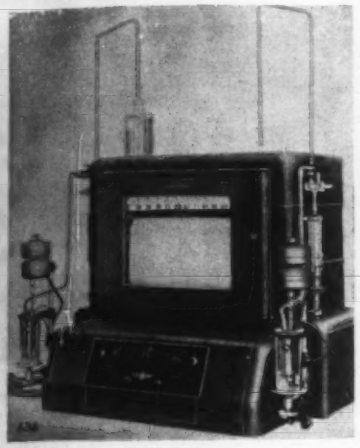


levers to multiply direct expansion of tube and supports interchangeable bronze spring closing valve (sizes 0.25, 0.375, 0.5 in.) with renewable disks for air, water, gas, oil, steam or gasoline. Temperature range is from minus 300 F. to 1800 F.—*Burling Instrument Co., 253 Springfield Ave., Newark* 3, *N. J.*

Mention No. 1214 when filling out card.

Titration Recorder

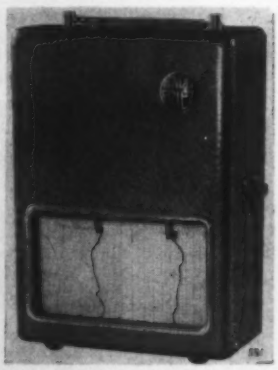
New "Dow Dual Recordomatic Titrometer" automatically runs and makes a record of oxidation and reduction as well as acid-base titrations using any of the following electrodes: glass, calomel, hydrogen, platinum, silver, antimony, and bimetallic. Reagent addition rate is automatically controlled to give rapid flow when buffering action is strong, and a drop-by-drop rate near end point. With two complete set-ups, one can be prepared while other is running. Depending on type of titration, one to five minutes running time are needed. Each division of chart travel equals 0.5 cc. titrant, ±0.05 cc, for total at end point. Available ranges are: 0 to ±1 volt, -0.5 to +0.5 volt, ±0.5 to ±1.5 volt, all accurate to 2 mv., and 0 to 10 pH or 4 to 14 pH, accurate to 0.02 pH. Instrument is housed in corrosion-resistant cabinet and over-all dimensions are 23 by 27 by 29 in. Shipping wt. is 450 lb. —*Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.*



Mention No. 1215 when filling out card.

Temperature and Humidity Recorder

New "Model 160" portable recorder has a temperature range of 0 to 110 F., and a relative humidity range of 10 to 95 percent. Charts are 3 by 5 inches, spring driven, for a 30 hour record. Thermometer is bimetallic, and hygrometer uses multiple-human-hair element.—*Friez Instrument Div., Bendix Aviation Corp., Taylor Ave., at Loch Raven Blvd., Baltimore 4, Md.*



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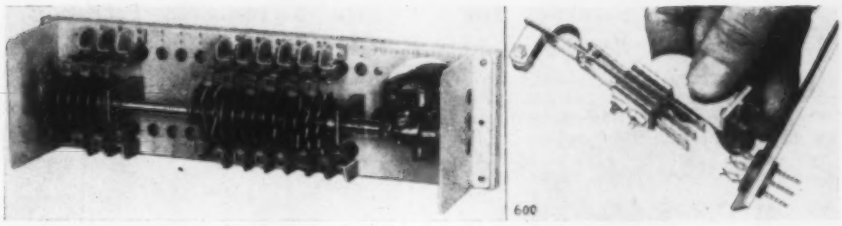

Multi-circuit, Two-speed-mainshaft Cycle Timer

New "Motor-driven Interrupter Machine" provides a sequence of automatic timing of controls. Within the cycles of 0.50 seconds to 2 minutes, any desired arrangement of coded pulses may be provided. Feature is interchangeability of all working parts. Contact make and break are created by snap-action switches (one-billion-operation life) running on case-hardened steel cams which can be custom-cut to provide specific intervals. Make or break can be tuned within 50 milliseconds of accuracy. Contacts have a rating of 7.5 amperes at 110 volts a.c. Planetary gears allow two speeds on main shaft. Shaft has an automatic torque limiter whereby, if a foreign object jams machine, motor may run for hours without damage. A standard speed-reducer motor is supplied, for 110-volt a.c. or 24-volt or 48-volt d.c. Model shown provides 28 circuits (cam and make-break spring combinations) and occupies a space of 22 x 6 x 6 inches. Right-hand photograph shows how switch mounting screws also control adjustment.—*Stromberg-Carlson, 109 Carlson Rd., Rochester 3, N. Y.*

Mention No. 1217 when filling out card.

Lens Calibrator

New "Transmission 'T' Stop Calibrator" measures true transmission of lenses and exact focal length. On the basis of these measurements, lens is rescaled in T-stop values, eliminating errors in old *f*-stop scale.—*Photo Research Corp., 127-129 West Alameda Ave., Burbank, Calif.*

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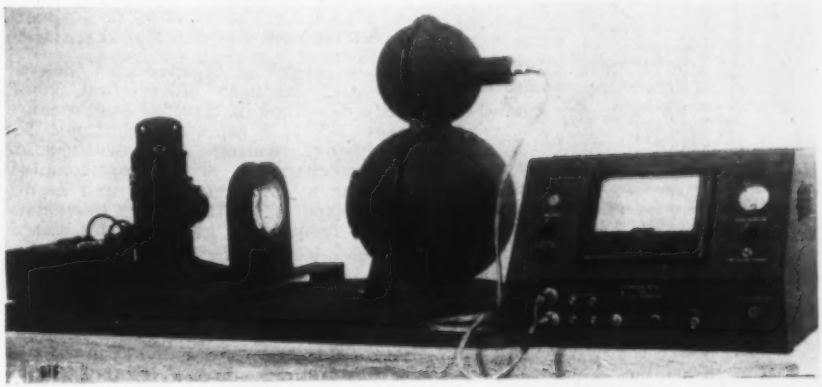

Color Densitometer for Photography

New "Spectra" color densitometer is entirely photoelectric in operation. Readings may be taken from 0.0 to 4.0 density, on either black-and-white or color films. Present model is designed to work primarily with standard IIa or IIb densitometer strips used in most laboratories; other models will be available for reading densities on large negatives and transparencies, and on opaque copy. Narrow-band filters are mounted: red for reading cyan densities, green for magenta and blue for yellow.—*Photo Research Corp., 127 W. Alameda Ave., Burbank, Calif.*

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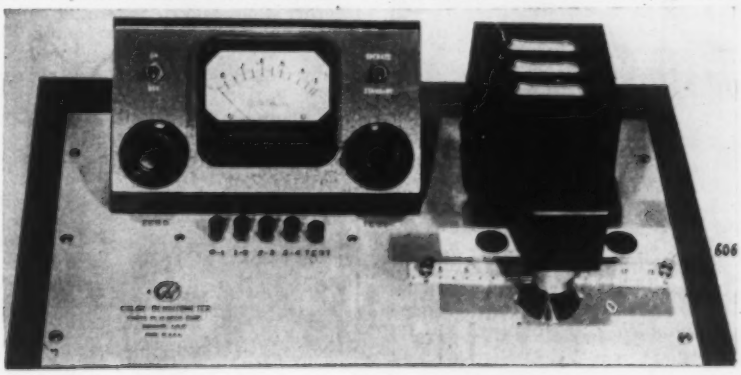
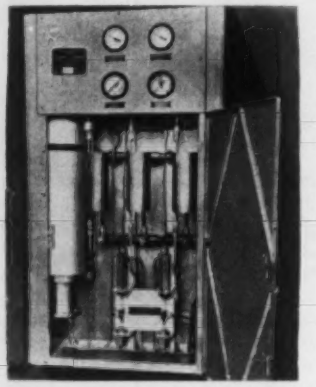
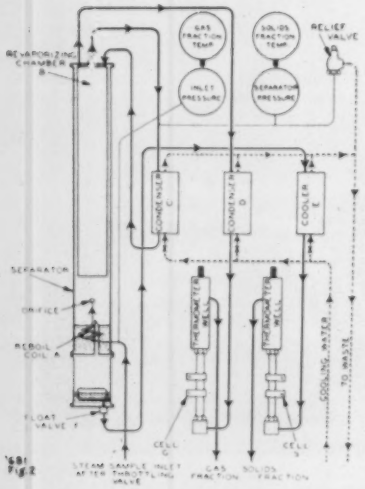


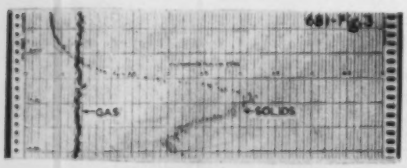
Continuous Sampler for Steam Purity

New "Automatic Degasser," for use in determination of steam purity, produces continuously and automatically an approximately 50-50 split of a flowing steam sample—one fraction of condensed steam containing any dissolved solids that may be present; the other any dissolved gases. In all field tests, carbon dioxide has been completely eliminated from fraction containing dissolved solids, and ammonia eliminated or greatly minimized: no gas influence on conductivity measurements. Fig. 3 shows how, in a typical case, it would be difficult without degasser to tell whether conductivity variations were due to gases, solids, or both. Other claimed advantages are: automatic operation; no frequent attention; installation easy and simple; low steam consumption (about 30 lbs. per hour); flowing steam and condensate contact only stainless steel; time interval from entrance of steam to outflow of degassed condensate from conductivity cell is about one minute. A second cell measures conductivity of gas fraction. Both fractions can be diverted for chemical analysis.—*Hagan Corp., Hagan Bldg., Pittsburgh* 30, *Pa.*





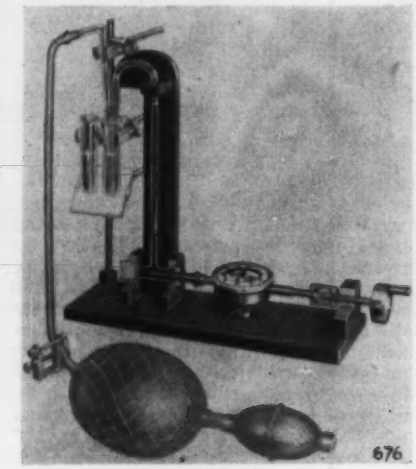
681-Fig. 2



Mention No. 1220 when filling out card.

Semi-automatic Titrator

New model of "Gilmont Ultra-Microburet" for rapid titrations shows four improvements over previous model: crank handle added for easier manipulation, swivel connection made for easy disengagement of screw, alignment assured with new gage mount, and support rod placed in new position to provide more space for test tubes and accessories.—*Emil Greiner Co.*, 20-26 *N. Moore St., New York* 13, *N. Y.*


676

Mention No. 1221 when filling out card.

Automatic-control Analog

New model of "Servoscope" has all essential features of original model fully described in Nov. '48 *Instruments*, page 1020; is especially designed for analyzing, testing and synthesizing servomechanisms or automatic-control systems by plotting phase and amplitude responses with respect to various signal frequencies generated by instrument. It accepts any carrier from 50 to 800 cps. without adjustment, modulates selected carrier with any envelope from 0.1 to 20 cps. (other ranges on special order). For use on d-c. servomechanisms, either sinusoids or square waves are available between 0.1 and 20 cps. Y-axis of oscilloscope used in conjunction with "Servoscope" may be conveniently switched back and forth between input and output of servomechanism being tested; X-axis may be conveniently switched back and forth between electronic sweep output of "Servoscope" and an unmodulated reference signal, permitting selection of either lateral-pattern-shift phase reading or rotating-pattern phase reading; accuracy 1 deg. Instrument has a new low-frequency electronic sweep which displays signal patterns on oscilloscope; operates on 115-volt 60-cycle power. —*Servo Corp. of America, New Hyde Park, N. Y.*

686

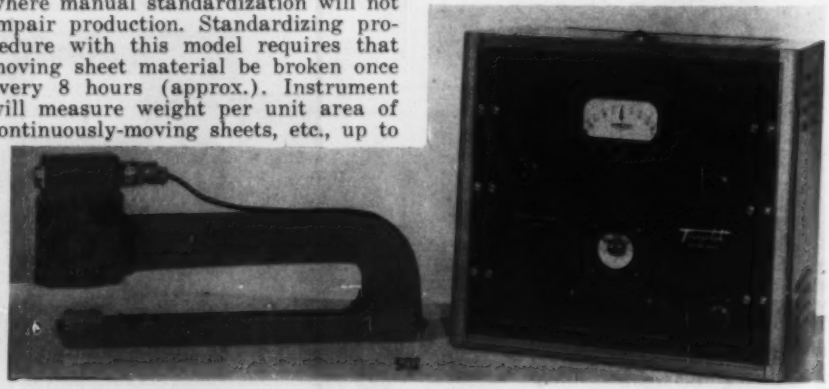
Mention No. 1222 when filling out card.

Recording Spectroradiometer

New recording spectroradiometer breaks up a light beam from any source into its spectrum, measures relative

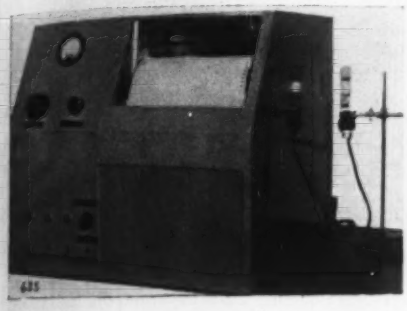
Continuous-reading Thickness and Density Gage

New "SM-3 Beta Gauge" is the second of a series of industrial measuring and control instruments using radioactive isotopes (for first, see *Instruments*, Sept. 1949, page 820). As in previous model, essential components are a source of beta radiation from strontium-90 and a radiation detector; sheet material to be measured passes between source and detector; part of radiation is absorbed by sheet material in proportion to its weight per unit area. New model is designed for use in small production lines where initial cost must be minimized and in processes where manual standardization will not impair production. Standardizing procedure with this model requires that moving sheet material be broken once every 8 hours (approx.). Instrument will measure weight per unit area of continuously-moving sheets, etc., up to 700 mg. per sq. cm. Weight (or thickness, if specific gravity is known) appears on illuminated scale of "Sensitrol." Operator can set manufacturing tolerances as a function of "Sensitrol" scale so that a red light (positive) or a green light (negative) flashes and, simultaneously, 115 volts a-c. appears on one of two sets of enclosed terminals on back of instrument to actuate auxiliary warning or control equipment.—*Tracerlab Inc.*, 130 *High St., Boston* 10, *Mass.*



Mention No. 1223 when filling out card.

spectral energy at each wave-length, and makes a permanent record of measurements on a graph. Instrument consists of a grating monochromator, photometer, recorder, and power supply. Measuring 25 by 27 by 23 in. and weighing 150 lbs, equipment can scan complete spectrum from 230 to 650 millimicrons at speeds varying from



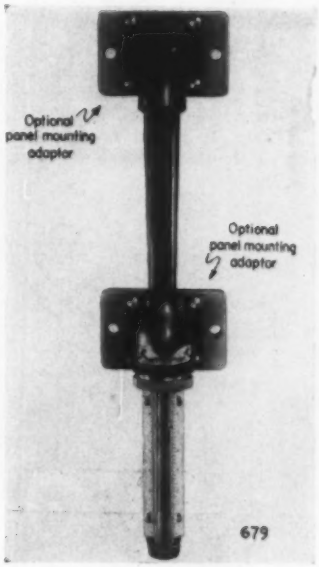
1 to 10 minutes, depending upon nature of spectrum. A curve is produced on a chart 9.87 by 24 in. for a luminous surface of brightness as low as 2 to 3 foot-lamberts.—*Special Products Div., General Electric Co., Schenectady* 5, *N. Y.*

Mention No. 1224 when filling out card.

Flow-rate Indicator

New "Floguide" variable-area gas flowmeter has tapered precision-bore metering tube and float fabricated from stainless steel. Metering tube is brazed to cast-iron inlet and outlet fittings. Extension below metering tube carries scale, and indicator below float permits direct reading of flow-rate. Instrument is available in capacities from 45 to 16,000 cfh. carbon dioxide, 200 to 76,000 for hydrogen, and comparable capacities for other gases. Max. working pressure is 600 psi. Max. temperature is limited by properties of available packings.—*Fischer & Porter Co., County Line Road, Hatboro, Pa.*

Mention No. 1225 when filling out card.



Temperature-standard Furnace

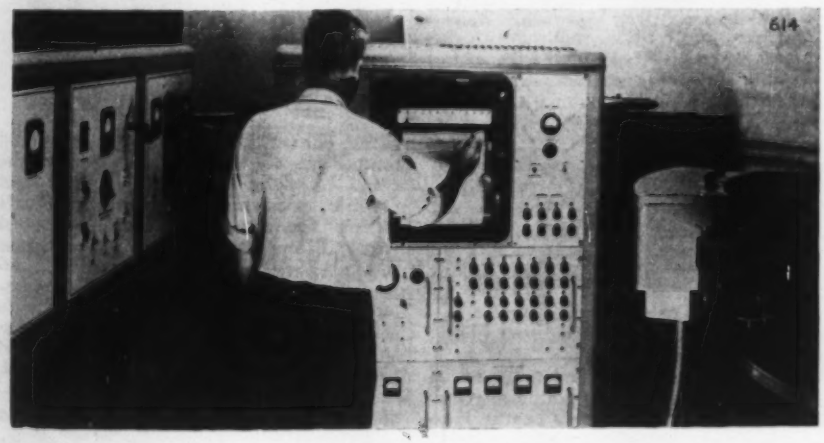
New "Type SB1" furnace for fixed-point checking of thermometers and thermocouples consists of an insulated quartz well in which is suspended a resistance-wire-heated quartz tube 1.5 in. O. D. closed at bottom. Furnace is suitable for obtaining melting-point check temperatures of pure elements up to copper. Dimensions are 4 in. diameter and 7 in. high.—*Paul G. Weiller, 95 Broad St., New York 4, N. Y.*

Mention No. 1226 when filling out card.

Equipment for Two-minute Analysis of Stainless and Tool Steels

New spectrochemical equipment, consisting of Two-meter Spectrometer, recording console and "Multisource," provides a direct-reading method of analysis for stainless steels, equivalent in accuracy to present routine chemical methods. Total time of analysis for all metallic elements is two to three minutes including sample preparation. Duplicate analysis on a single sample for these constituents can be made in a total time of three to four minutes. Precision attained for chromium and nickel is said to be much higher than has ever been reported for any spectro-chemical system. A variety of rolled and cast samples repeatedly provided standard deviations from 0.3 to 0.4 percent of the quantity measured. Thus for an 18 percent chromium determination this represents an error of 0.07 percent; for an 8 percent nickel determination an error of 0.03 percent.—*Applied Research Labs., 4336 San Fernando Rd., Glendale* 4, *Calif.*

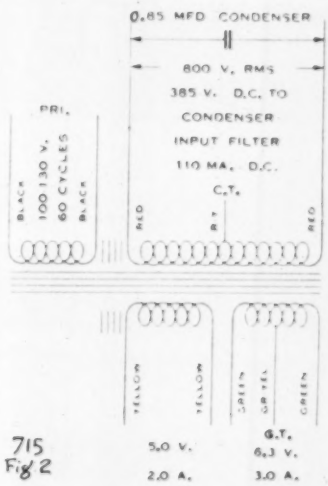
Mention No. 1227 when filling out card.



Constant-voltage Transformer

New "CVE" constant-voltage transformer introduces feature of regulation built into power supply transformer

for electronic circuits, thereby obviating need for purchasing separate components. Line voltage variations from 100 to 130 produce fluctuations of 3



percent or less in output windings. Transformer will be available in three models. Typical schematic is shown in Fig. 2. Size and weight are said to be slightly greater than for unregulated transformers.—*Sola Electric Co., 4633 W. 16th St., Chicago* 50, *Ill.*

Mention No. 1228 when filling out card.

Long-stem Resistance Thermometers

New long stems now bring length of glass or quartz thermometer tubes to 9 or 14 in. Stems are 0.320 in. diameter, and tips are either 0.140 or 0.200 in. Windings are copper, nickel, tungsten, or platinum, with resistances from 25 to 400 ohms at the ice point. Temperature ranges are from those of liquid gases up to 2200 F. Leads are 3 ft. long.—*Paul G. Weiller, 95 Broad St., New York 4, N. Y.*

Mention No. 1229 when filling out card.

Well-logging Apparatus

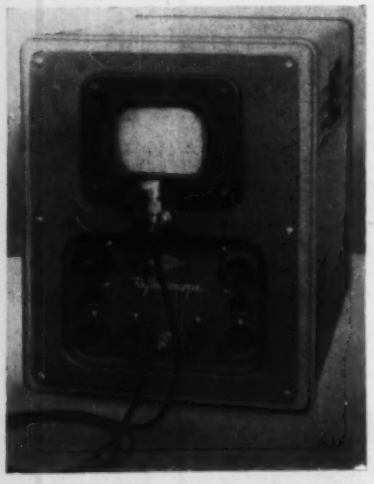
New portable electrical logging device especially designed for water wells consists of two parts: a reel containing logging line and electrode, with counter for measuring depth, and measuring instrument in a portable

synthetic-leather case. Handlogger runs both standard potential and resistivity curves, and is direct-reading. Standard model is designed for wells 500 feet or less in depth, but modifications can be made to meet other conditions.—*Instrument Div., Carl A. Bays and Associates, P. O. Box* 189, *Urbana, Ill.*

Mention No. 1230 when filling out card.

Ultrasonic-principle Tester for Metals

New "Type UR, Style 50E351, Reflectoscope" replaces previous "Type SRO5," features functional changes in styling and external design together with modifications which facilitate interpretation of test results. Design changes include recessed controls and carrying handles; removable bracket for holding searching unit when not

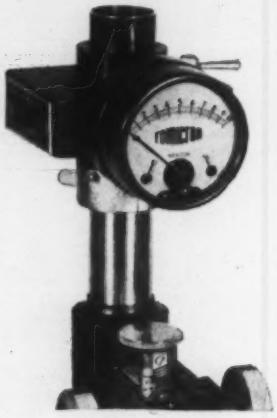


in use; removable cover containing space for carrying all searching units and necessary cables. An improved pattern of square-wave "inch markers" on horizontal axis of screen facilitates interpretation of test results. Also, a new "Reject" control gives operator additional control of sensitivity by rejecting indications of small defects which do not affect performance of the part or material under test. Operating principle is same as that of previous model (see *Instruments*, June 1946, page 359).—*Sperry Products, Inc., Danbury, Conn.*

Mention No. 1231 when filling out card.

Microphotometer

New "Romicron C. G. Grand" microphotometer is especially designed for use with a microscope. Indicator is a microammeter with arbitrary scale of ten divisions. A range switch mounted on side of housing permits a change

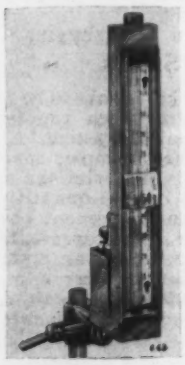


of sensitivity and, by means of a female plug, an amplifier or galvanometer may be attached to increase scope of instrument. Also available are iris-diaphragm eyepiece with observation telescope and beamsplitter for measuring small areas and specific sections of a specimen.—*Paul Rosenthal,* 505 *Fifth Ave., New York* 17, *N. Y.*

Mention No. 1232 when filling out card.

Portable Field Manometer

New portable manometer is provided with bubble level and universal ball and socket type clamp for mounting on piping. Made of stainless steel with precision-bore tubing, it has a



sliding magnifier for readings to 0.2 in. water. Scale is graduated in inches of water pressure, using mercury, calibrated dry. Range is from 0 to 110 in. of water. Case measures over-all 5 in. wide, 3 in. high, and 14 in. long. Assembly weighs 7.5 lb.—*The Meriam Instrument Co.,* 10920 *Madison Ave., Cleveland* 2, *Ohio.*

Mention No. 1233 when filling out card.

X-ray Thickness Gage

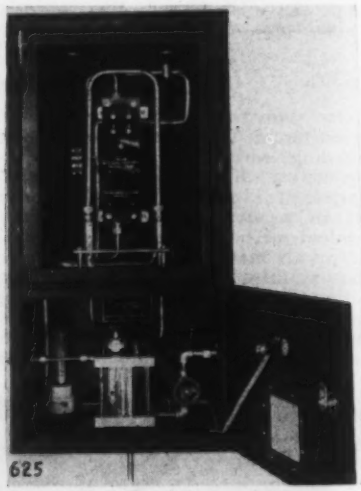
New model of maker's x-ray thickness gage, designed to measure in steps of 0.0001 inch cold rolled steel strips ranging in thickness from 0.0050 to 0.1196 inch, compares amount of x-ray absorption from two x-ray beams iden-

tical in intensity, one through a steel sample of exact thickness to be rolled; the other through strip being rolled. Illustration shows operator's control station: upper line of controls may be set to operate tolerance-limits indicator lights (for high-speed mill applications) or to operate reject gate on a classification line. Second line of controls is provided to energize and calibrate gage. Third line of controls automatically sets up sample thickness of steel to be rolled: thickness of sample in standard x-ray beam is shown in windows above these controls. Electrical and radiation protection safeguards personnel. Equipment is sealed to hinder entry of dust and moisture.—*Westinghouse Electric Corp., P. O. Box* 868, *Pittsburgh* 30, *Pa.*

Mention No. 1234 when filling out card.

Flue Gas Analyzer

New indicating and recording thermal-conductivity-type gas analyzer scrubs and conditions flue gas sample by means of a gravity type water aspi-

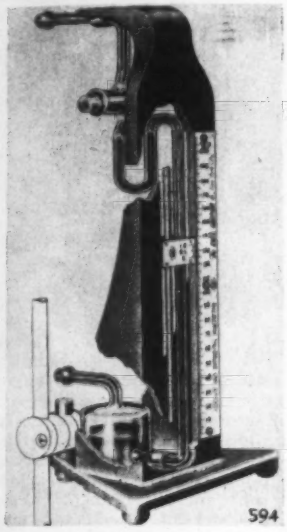


rator, controlling moisture content and temperature of sample, and at the same time removing sulphur dioxide and foreign matter. Filament block is milled from a solid stainless steel block; filaments are mounted on glass insulated posts on a removable stainless steel cover plate, and cell compartment is insulated and dust-tight with temperature thermostatically maintained.—*Davis Emergency Equipment Co. Inc.,* 80 *Halleck St., Newark* 4, *N. J.*

Mention No. 1235 when filling out card.

Absolute and Differential Manometer

New model of maker's absolute and differential manometer has: protective bracket for stopcock; rod on back of stand for mounting on frame; new metal rod to carry vernier; vernier mounted on a block containing a U cut out to eliminate parallax; special

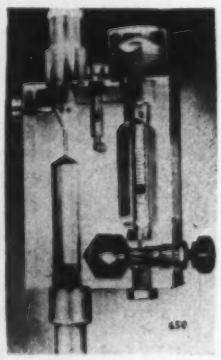


hollow-ground high-vacuum stopcock on glass part. Only one reading is required to obtain precise measurement automatically corrected for ambient temperature and reduced to a height of mercury at 0 C.—*Emil Greiner Co., 22 N. Moore St., New York 13, N. Y.*

Mention No. 1236 when filling out card.

Chemical Feeder

New "Feed-Rator" made of transparent acrylic plastic controls, meters and dispenses relatively small amounts of reagents into a larger stream. Built-in eductor takes place of a pump, and many highly-corrosive chemicals can therefore be fed directly from a con-

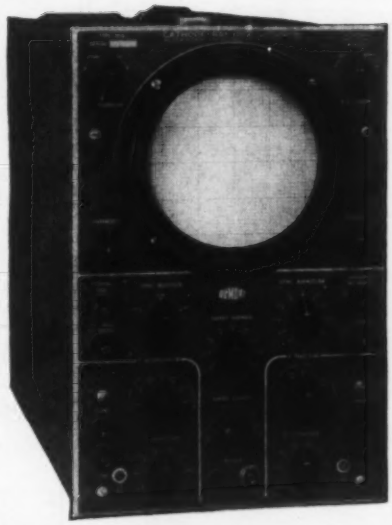


tainer. Units will treat up to 7000 gallons per day of water directly. In a bypass arrangement, 5 parts per million of reagent can be delivered to over 14,000,000 gallons of water per day.—*Fischer & Porter Co., Hatboro, Pa.*

Mention No. 1237 when filling out card.

Oil-burner Regulator

New "L-25," for gravity-type feed oil-fired burners, is said to be an entirely new type of regulator, employing



It's a lot easier with the right-sized screwdriver!

LIKEWISE . . .

Your CATHODE-RAY oscillography can be a lot easier with the

Du Mont Type 304-H
CATHODE-RAY OSCILLOGRAPH

★ Make it the *easier* and *better* approach to those mechanical problems involving pressure variations . . . timing of slow-moving parts . . . minute vibrations . . . complete monitoring of overall operations . . . small displacements . . . and many other applications. Use the new Du Mont Type 304-H Oscillograph because of such features as:

HIGH-GAIN AC and DC AMPLIFIERS . . .

Both X- and Y-Axes have AC and DC amplifiers. Y-Axis sensitivity is 10 millivolts rms per inch; X-Axis is 50 millivolts rms per inch. Frequency response of the DC amplifiers is uniform within 10% from 0 to 100,000 cps; of the AC amplifiers, within 10% from 20 to 100,000 cps. Stability of these amplifiers is excellent, and microphonics and drift are at a minimum.

RECURRENT AND DRIVEN SWEEPS . . .

Variable from 2 to 30,000 cps, with provision for readily obtaining sweep durations of ten seconds or more by use of external capacitors.

EXPANSION OF DETAIL . . .

Available deflection over 5 times full-screen diameter, with no visible distortion when positioning over the entire range. This gives big-tube visibility with small-tube resolution.

INCREASED ACCELERATING POTENTIAL . . .

Du Mont Type 5CP-A Cathode-Ray Tube used is operated at overall accelerating potential of 3000 volts, fully utilizing long-persistence screens, low-frequency sweeps, and DC amplifiers.

Type 304 Cathode-Ray Oscillograph, having identical characteristics except for lower accelerating potential, is also available at slightly less cost.

STABILIZED SYNCHRONIZATION . .

Both sweep length and synchronization level are maintained as signal amplitude varies.

INTENSITY MODULATION . . .

15 volts peak input at the Z-Axis terminal will blank a trace of normal intensity.

ADDITIONAL FEATURES . . .

Engraved, permanently mounted calibrated scale for precise quantitative measurements. Mu-metal shield for Type 5CP-A tube. Du Mont 2501 Bezel for attaching photographic accessories.

MECHANICAL DETAILS . . .

Height, 13½"; Width, 8⅝"; Depth, 19"; Weight, 50 lbs.

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Commercial Centerless' exacting job of manufacturing machined instrument parts, with finishes often less than one microinch, requires checking so accurate that ordinary means of inspection are as outmoded as the stone hatchet.

By using the "Surface Analyzer" they prove to their customers and themselves that precise surface specifications are accurately met. Along with the product goes a hill and dale "picture" of the character and average roughness of the surface, instantaneously printed on chart paper—magnified 39,370 times!

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Check the chart paper against specifications, then send it along with your product to your customer. He will appreciate knowing absolutely that specifications have been met.

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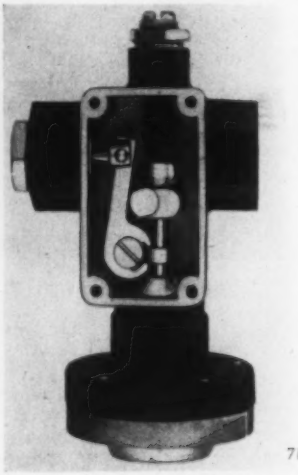
maker's exclusive compound-lev[illegible]action whereby slightest movement of [illegible]n exceptionally small diaphragm [illegible]tuates needle valve, so that fuel flow [illegible]ate is increased or decreased gradu[illegible]ly as steam pressure varies. Another [illegible]dvantage is that "L-25" can be mou[illegible]ted in



any position. New lever and valve system has also made possible smallest size (5.5 inch over-all) and lightest weight (36 oz.) of regulator with half-inch inlet pipe size and quarter-inch outlet pipe size. Standard eighth-inch orifice may be increased. Regulator comes factory-adjusted to specified steam pressure but may be easily readjusted.—*Superior Controls Co., Inc.*, 1835 *Bonnie Brae, Los Angeles* 6, *Calif.*

Mention No. 1238 when filling out card.

Color Temperature Indicator

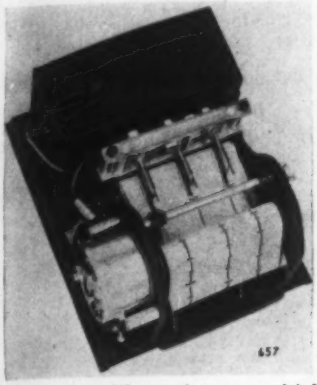
New "Spectra Type B" color-temperature indicator is direct-reading. User points it at source of illumination, rotates a ring until pointer is brought to zero, then reads from a scale either color temperature in degrees Kelvin or

number of filter required to bring the light into balance with the color film being used. For use both indoors and out, instrument has four scales: one reads degrees Kelvin from 2600 to 10,000; other three are for Daylight, Type A and Type B film, reading directly in filter numbers. Instrument is designed to work with "CT" filters marketed by maker and also Eastman CC and Harrison filters.—*Photo Research Corp.*, 127 *W. Alameda Ave., Burbank, Calif.*

Mention No. 1239 when filling out card.

Ride Recorder for Shipping

New "Impact-O-Graph" measures impact or drop in three directions—forward and back, up and down or sideways. Three stylii, or markers, record extent of impact on a special wax-

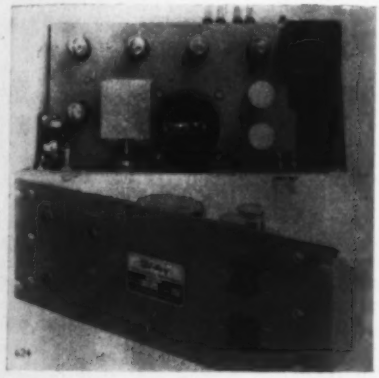


treated and calibrated tape which is driven by a silent electrically-wound clock one inch per hour. Sufficient tape is carried on roll to last 28 days. Clock mechanism will operate 60 days on one battery.—*Cleveland Impact Recorder, Inc., Union Commerce Bldg., Cleveland 14, Ohio.*

Mention No. 1240 when filling out card.

Frequency Standard

New Frequency Standard employing a 100-kc. crystal, features a 24-hour frequency stability of two parts in ten million when subjected to line voltage fluctuation of 10 percent. Under adverse conditions of temperature,



humidity and semi-portable operation, instrument will maintain an accuracy of 2 parts in one million for a 30-day period without resetting. Frequency source is maker's GT-cut quartz crystal unit temperature-stabilized to within 0.1 C. in a specially-designed oven employing a mercury thermostat and external relay.—*Bliley Electric Co., Erie, Penn.*

Mention No. 1241 when filling out card.

Secondary Frequency Standards

New "100C" and "100D'" secondary frequency standards replace earlier models "100A" and 100B," New "100D" offers rectangular wave output, timing pips at intervals of 100, 1,000 and 10,000 microseconds, and internal oscilloscope for convenient frequency comparison; may be conveniently standardized against U. S. Government Radio Station WWV. Both models employ crys-

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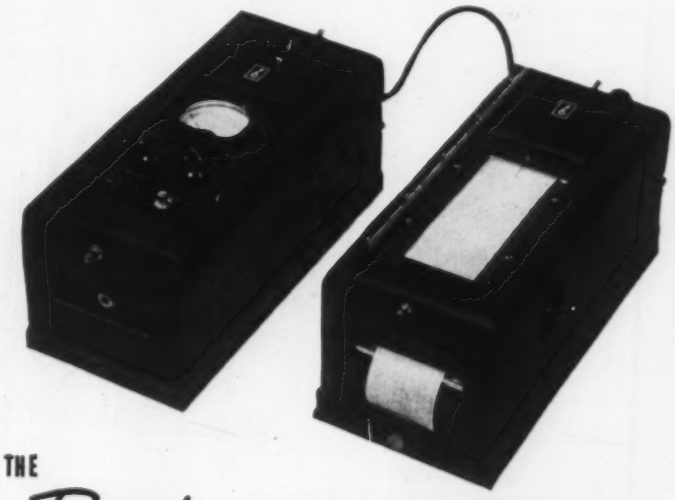

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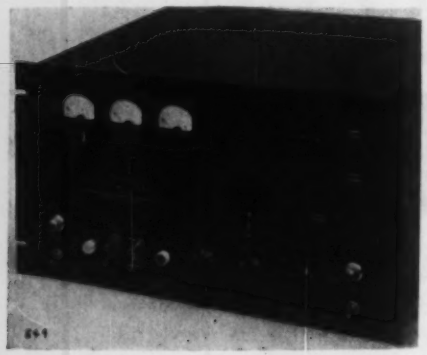
tal-controlled oscillator and divider circuits. Standard frequencies can be selected on a front panel switch and may be employed simultaneously. Internal impedance has been held to about 200 ohms. "100D"' offers sine waves at 5 frequencies and rectangular waves at 4 frequencies. Accuracy is about 2 parts in 1 million. "100C" offers sine waves only, at 4 crystal-controlled frequencies. Accuracy is 0.001 percent. Both instruments provide 5 volts output at all frequencies, and operate from a self-contained 115-v. regulated a-c. power supply.—*Hewlett-Packard Co.*, 395 *Page Mill Road, Palo Alto, Calif.*

Mention No. 1242 when filling out card.

Wide-range Power Oscillator

New, "Type 124 A" wide-range power oscillator, developed for measurement and testing procedures in the 300- to 2500-Mc. range, consists of a grid-

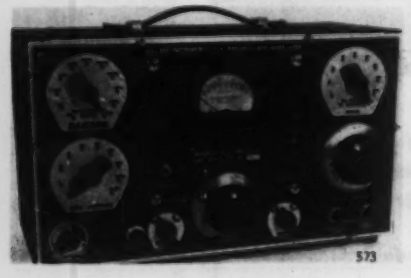


separation coaxial oscillator, an audio-oscillator and modulator section and a self-contained rectifier power supply. Counter-type indicators show position of tuning elements. An output coupling control with counter indicator is also provided.—*Airborne Instruments Laboratory, Inc.*, 160 *Old Country Road, Mineola, N. Y.*

Mention No. 1243 when filling out card.

D-C. Amplifier and Millivoltmeter

New "Model DCA-3" has a sensitivity of better than 1 mv. full scale at 6



megohms input impedance, a range of 50 microvolts to 1,000 volts, and an output up to 5 ma. d.c. for recorder operation. Adjustable negative feedback provides linearity and a built-in calibrator permits checking of gain and scale calibration during testing. 120-cps. carrier output operates a-c. relays. Input and output impedances are adjustable. Drift from day to day is imperceptible. —*Millivac Instruments, P.O. Box* 3027, *New Haven, Conn.*

Mention No. 1244 when filling out card.

Hearing-aid Battery Tester

New "No. 10" hearing-aid battery tester utilizes one cord; can be plugged into any type or size of hearing aid battery for instant reading. Batteries

are tested without regard to polarity. Instrument reads either side of scale, from zero to center, on any type of "A" or "B" batteries. A dual contact prod marked "A" at one contact and "B" at the other is inserted into corresponding battery. Tester is designed for use on 1.5 v. and 1.2 v. "A" batteries and 15 v., 22.5 v. and 45 v. "B" batteries.—*Sterling Mfg. Co.*, 9205 *Detroit Avenue, Cleveland, Ohio.*

Mention No. 1245 when filling out card.

UHF Oscillator

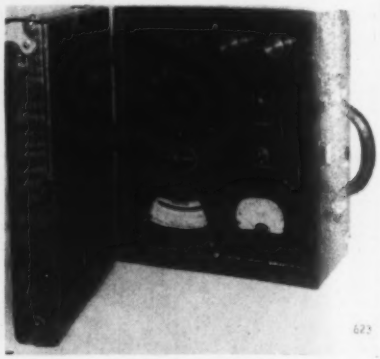
New "Model 112" UHF oscillator covers frequency range of 300 Mc. to 1000 Mc. Calibration is accurate to 0.5 percent. Unit has self-contained power supply. Provision is made for use of a d-c. power source when maxi-

mum stability is required. Output voltage varies with frequency between 0.3 volt and 2 volts. Output dial, calibrated in db, makes possible relative voltage measurements.—*Measurements Corporation*, 116 *Monroe Street, Boonton, N. J.*

Mention No. 1246 when filling out card.

Low-resistance Tester

New "Model 151-S Microhm Meter" is a portable dry-cell-power five-range instrument for checking low-resistance values in contacts, joints,

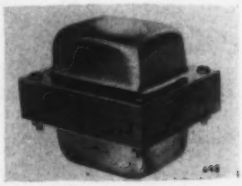


windings, material tests, etc. Ranges: 0-75; 0-750; 0-7500; 0-75,000 and 0-750,000 microhms. Internal shield protects against stray field effects. 20-ft. leads permit use in locations ordinarily difficult to reach. Case has protected corners and removable cover. Dimensions 8 x 10 x 6 in.; weight 18 lbs.—*J. W. Dice Co., Englewood, N. J.*

Mention No. 1247 when filling out card.

Transformers for Instrumentation Uses

New "Yeoman" line of transformers incorporates same standards of performance as maker's "Quality Plus" transformer series. Transformers are



lightweight units with open frame construction and ten-inch leads. Line includes impedance-matching, input, output and power transformers in models for all applications.—*Audio Development Co.*, 2833 13*th Ave. South, Minneapolis, Minnesota.*

Mention No. 1248 when filling out card.

Sweep Calibrator

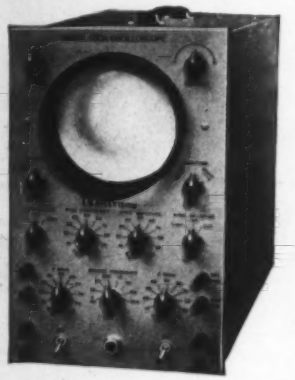
New "Model GL-22A" sweep calibrator is designed to provide markers for accurate time calibration of synchroscopic sweeps. Markers at intervals of 0.1, 1.0, 10.0, and 100.0 microseconds are provided and are suitable for deflection-indicating or beam-blanking presentation. A self-contained trigger generator with positive or negative output can be used to drive calibrator

and associated equipment or it may be triggered externally up to approximately 100 kc. Positive or negative gates of variable amplitude are available for obscuring retrace or timing purposes.—*Browning Laboratories Inc., Winchester, Mass.*

Mention No. 1249 when filling out card.

Cathode-ray Oscilloscope

New "Model 450 A" 5-in. oscilloscope is a wide-band high-gain instrument with vertical amplifier response to 1 Mc., a sensitivity of 0.15 rms volts per inch, horizontal amplifier



range 2 cps. to 500 kc., frequency-compensated decade attenuators, direct connection to deflection plates, calibration test signal, and sweep frequency to 50 kc.—*Transvision, Inc., New Rochelle, N. Y.*

Mention No. 1250 when filling out card.

Voltage Stabilizer

New "multiple-unit" type voltage stabilizers, for capacities in excess of 2 kva., come in multiple sections of 500- or 625-watt capacities built up on rails and connected in parallel with input and output connections located in a separate junction box. This permits quick assembly of any specially-desired rating through use of standard components. Capacities can be built up to 10,000 watts. Multiple-unit stabilizers deliver controlled output voltage to 0.5 percent over their full rating.—*Dep't. 6460-NR-1, Raytheon Mfg. Co., Waltham 54, Mass.*

Mention No. 1251 when filling out card.

Multi-purpose Aircraft Radio

New "Model LTRA-5 Deluxe VHF/LF Transmitter-Receiver" is said to bring to all aircraft owners the only automatic VFH navigating equipment. ("Omnimatic") with combination

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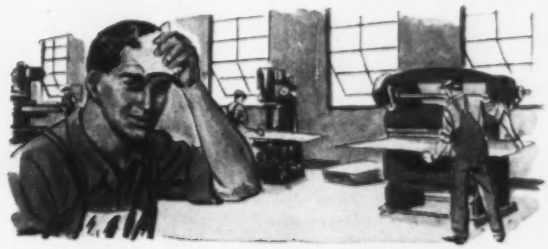

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LT 820	60-1600 F.	Iron-Constantan
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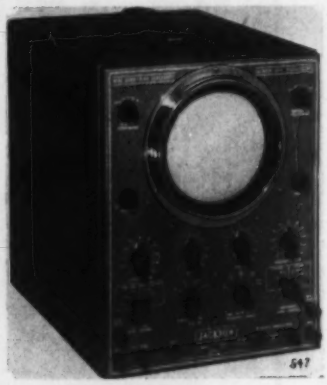
Mention No. 1252 when filling out card.

Cathode-ray Oscilloscope

New "Model CRO-1" oscilloscope has a sensitivity of 0.018 volts per in. and a 4.5-Mc. band width. A flat frequency response within plus or minus 1.5 db is claimed for sine waves from 20 cps.



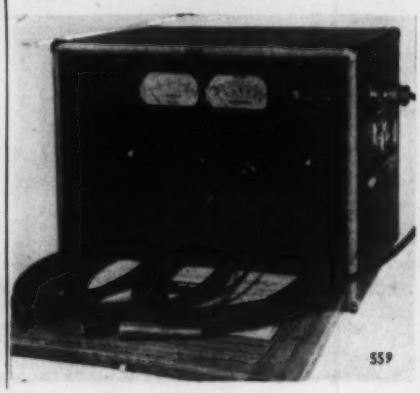
to 4 Mc. with a useful range up to 5 Mc. Saw-tooth sweep frequency is adjustable from 20 cps. to 50 kc. in 5 steps. High or low sensitivity and wide or narrow range are available at will by the flip of a switch.—*Jackson Electrical Instrument Co.*, 18 *S. Patterson Blvd., Dayton 1, Ohio.*

Mention No. 1253 when filling out card.

Insulation Tester

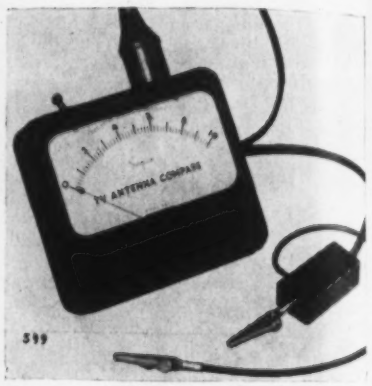
New "Model 184C" portable insulation tester has four voltage ranges providing continuously-variable d-c. voltages up to 10 kv., all regulated within 0.5 percent. Resistances from 0.1 to 50,000 megohms may be read directly on a megohmmeter scale at open-circuit voltages of 0.5, 1, 5, and 10 kv. or may be simply calculated in ranges from 0.3 to 20,000 megohms from readings of a voltmeter and microammeter connected to read resistance at any desired test voltage operating from zero volts to 10 kv. Alternate methods are selected on one switch. Leakage current ranges are 30, 150, 300 and 1500 microamperes, readable at any voltage. A shield terminal provides a guard circuit which by-passes instrument to avoid false readings. A polarity-reversing switch is provided for polarization checks. Tester operates from a 115-volt 60-cycle line, consumes a maximum of 65 watts.—*Radio Frequency Laboratories, Inc., Boonton, N. J.*

Mention No. 1254 when filling out card.



TV Antenna Compass

New "Model 351" TV antenna compass is a pocket-size instrument, connected by an insulation-piercing alligator clip to video input of cathode-ray tube in television receiver. By an extension cord, it is carried to antenna site. With a test pattern tuned in on area's weakest station, antenna is rotated for maximum deflection of compass. With this instrument, user can also peak the r-f. and oscillator systems on the station itself.—*Simpson Electric Co.*, 5200-18 *W. Kinzie St., Chicago, Ill.*



Mention No. 1255 when filling out card.

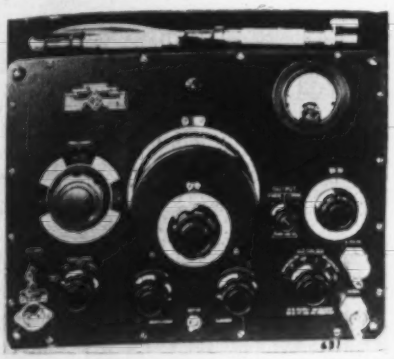
Sealed-in-glass Geranium Diodes

New germanium crystal diodes in hermetically-sealed glass cartridges are available in two types: "IN34A" general-purpose and "1N58A" 100-volt. Electrical characteristics and ratings of new "glass" type crystals are the same as those for corresponding "ceramic" types. New terminal design permits units to be mounted side-by-side without danger of shorting.—*Electronics Div., Sylvania Electric Products Inc.*, 500 *Fifth Ave., New York* 18, *N. Y.*

Mention No. 1256 when filling out card.

Standard-signal Generator

New "Type 1001-A" standard-signal generator is a general-purpose, amplitude-modulated generator suitable for standard IRE and RMA tests on radio receivers. Frequency range is 5 kc. to 50 Mc. with logarithmic frequency dial and an auxiliary frequency-increment dial. Output voltage



range is 0.1 microvolt to 200 millivolts at panel jack; 0.05 microvolts to 100 millivolts at end of a terminated cable. Output impedance is 10 ohms at panel jack, 50 ohms at end of unterminated cable, or 25 ohms at end of terminated cable. Internal modulation at 400 cps. up to 80 percent is provided. External modulation can be used from 20 cps. to 15 kc.—*General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.*

Mention No. 1257 when filling out card.

Combustion Safeguard

New "1300 Series Flame-otrol" combustion safeguard uses the flame itself in a simple electronic circuit to provide instantaneous switching action. It is capable of detecting the presence or absence of a gas or oil flame of any type of burner. It features interchangeable plug-in units for increased program variety, for both manual or automatic ignition applications, easily adjustable to a wide selection of purge, pre-ventilating and ignition program cycle combinations, and provides a complete self-checking cycle of operation from safe-start to safe-shut-off for any type of gas- or oil-fired heating equipment.—*Wheelco Instruments Co., 847 W. Harrison St., Chicago 7, Ill.*

Mention No. 1258 when filling out card.

Peanut Moisture Meter

New "TAG-Heppenstall Peanut Moisture Meter" requires no weighing of samples before testing; is said to be the first peanut moisture meter to employ principle of conductivity as a method of testing. Tests can be made in a few

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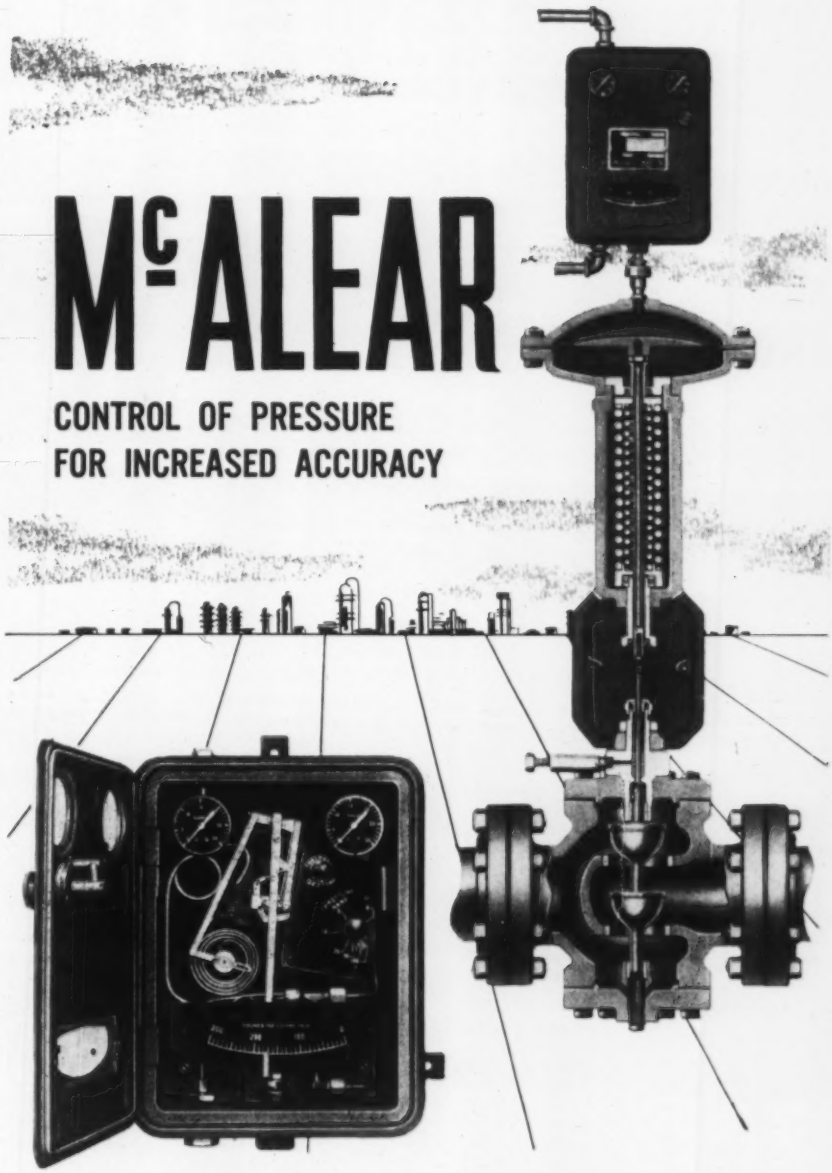

These McAlear units offer a completely coordinated "package" for installation wherever sensitivity of control is required.

McAlear No. 115 and No. 116 Diaphragm Motor Valves—Equipped with ball bearings and multiple springs. No. 115 is spring opened and pressure closed while No. 116 is spring closed and pressure opened. Available in semi-steel or cast steel, or other metals, suited to various pressures, temperatures and services. Sizes from ½" to 12".

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seconds. Instrument is calibrated for popular varieties; can be used with either whole or shelled nuts.—*J. Tagliabue Corp. (N. J.), 614 Fellinghuysen Ave., Newark 5, N. J.*

Mention No. 1259 when filling out card.

Motor Speed Controller

New "Type 1701-A Variac" controls speed of a 1/20 h.p. d-c. shunt motor or a 1/15 h.p. universal motor directly from a-c. line. Range of continuous speed variation available is from motor rated speed down to nearly zero at constant torque. Working range of 30:1 can be obtained with shunt motors, and of at least 50:1 with most

universal motors. Motor can be reversed almost instantly by flipping the forward-reverse switch. A "Variac" auto transformer supplies continuously-adjustable voltage to armature through a selenium rectifier and choke. A fixed field voltage is provided by another selenium rectifier. No protection for starting load or momentary overload is necessary, but a slow-blow fuse is provided as protection against damage from stalling when starting an excessively heavy load.—*General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.*

Mention No. 1260 when filling out card.

Neutron Counter Tubes

New "Mark 2, Model 2" slow neutron counters are now available with enriched boron-10 content for increased efficiency. Boron trifluoride contains 96 percent boron-10, corresponding to an enrichment of about 4.8 times normal. Standard size: 2-in. diam., 12-in. active length, 0.032-in. brass wall. Standard filling pressure: 12 cm., 40 cm. Special sizes and filling pressures on request. United States Atomic Energy Commission approval required for purchase of enriched counters.—*Radiation Counter Laboratories, Inc., 1844 West 21st St., Chicago 8, Ill.*

Mention No. 1261 when filling out card.

Radioactivity Survey Meter

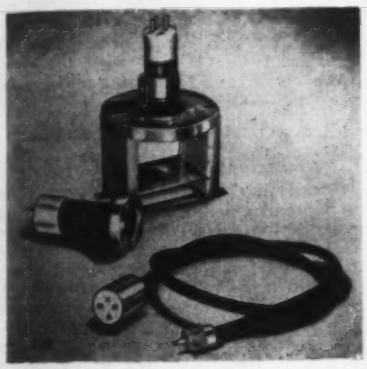
New "Model K-802" detects and measures beta and gamma rays. Two standard flashlight batteries power the unit through a vibrator power supply which furnishes high voltage for Geiger tube. Tube is plug-in type, replaceable in the field. Simple on-off switch control is employed. For classroom use, unit may be connected to PA system. Instrument is small, (6.5 x 3.75 x 2.25 in.) and light (2 lb.). Magnetic type phones

having 1000 to 24000 ohms impedance can be used.—*The Kelley-Koett Co., West Fourth St., Covington, Ky.*

Mention No. 1262 when filling out card.

Mica-window Radiation Counter Tube

New "Fusion Seal Mica-Window Counter," in which window is fused to glass tube body, has a guaranteed shelf life of 6 months, and a useful life of 100



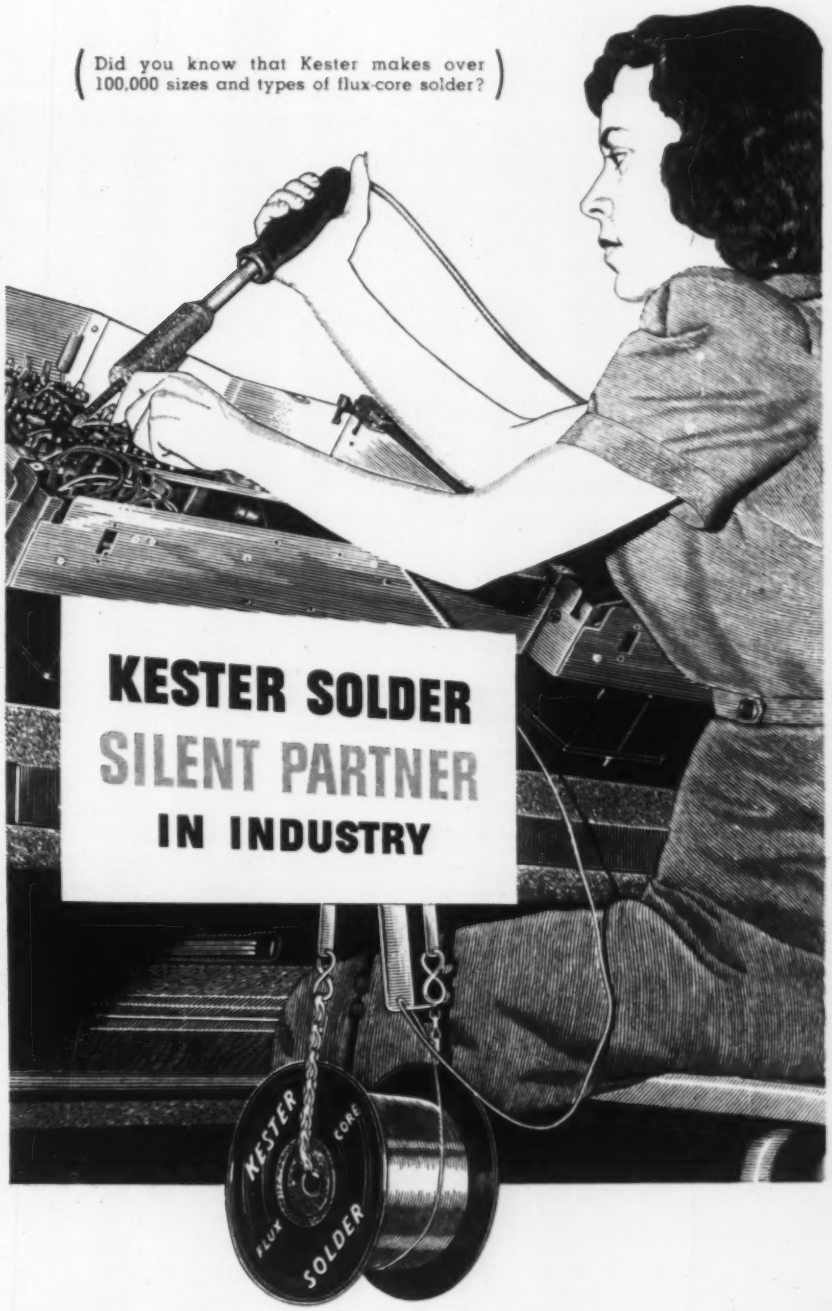
million counts. For beta ray counting, window thicknesses from less than 2 to 4 mg. per sq. cm. are available. Threshold is at approx. 1100 volts, and plateau is approx. 200 volts. Standard 4-prong tube base.—*Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill.*

Mention No. 1263 when filling out card.

Gas-flow-type Radiation Counter Tube

New "Type K Windowless Flow-Counter" may be used for alpha, beta or gamma radiation. Operating voltage is less than 1500 with a plateau of several hundred volts. Inexpensive gas flows slowly through tube and gives self-quenching operation with unlimited life.

Did you know that Kester makes over 100,000 sizes and types of flux-core solder?



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There's Still Time to Enter the $500 Instrumentation Contest

SPECIAL ANNOUNCEMENT.—Owing to requests from contestants who have to get clearance, or otherwise suffer delays, the closing date is postponed to JANUARY THIRTY-FIRST, 1950.

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SPONSOR: The Instruments Publishing Co., Inc.

THEME: **"Instruments Cut Costs."**

PRIZES: First Prize, $200; Second Prize, $100; Third Prize, $75; Fourth Prize, $50; three Fifth Prizes of $25 each.

ENTRIES: Each contestant is to submit an original essay, report, dissertation, etc. (hereinafter termed an "entry") bearing upon the Theme of the Contest.

"Instruments." The device or apparatus whose uses are described may be anything from a simple gage to a complete installation of interlocked and coordinated process controllers. Automatic-gaging, automatic-testing, and automatic-inspection set-ups, likewise, are suitable subjects. So are meters. So are electronic devices and many useful "gadgets."

"Report." This type of entry may briefly describe a single case and be written in telegraphic style; or it may present detailed statistics covering a twenty-year period; or it may analyze a whole industry. In this type of entry the data—the numerical "scores"—count more than the style of writing. An entry consisting of charts and tables—with only one paragraph of text—would be acceptable. This "graphic" type of entry is the easier to prepare by entrants who have already gathered statistics or who can gather them.

"Essay" (limit, 1000 words). In this type of entry, the manner of presentation must make up for the possible absence of statistical data; but FACTS must be presented. Wherever exact figures are difficult to obtain, case-studies must be analyzed to support the conclusions.

"Reports" should not be padded with a number of charts and tables copied from books, journals, etc.; pertinent abstracts suffice. "Essays" must not exceed one thousand words. Brevity and conciseness will count in grading all entries.

Each contestant may submit as many different entries as he desires.

Entries need not disclose new and patentable instrument ideas: what you are doing with known instruments may be new and widely useful.

Authenticity: Source of data should be given. Manuscripts made up of assertions, figures, charts, etc.—even the most impressive—risk being disqualified if the facts and figures are not verifiable. After the judging, all manuscripts receiving Prizes or Honorable Mentions will again be checked for accuracy and authenticity before the list of winners is made public.

All "essays," and all textual portions of "reports," must be typewritten, with lines double-spaced or triple-spaced, on one side of the sheet. All charts and other drawings must be in India ink on white paper or clean tracing cloth, suitable for black-and-white reproduction. (No pencil-shaded areas or other treatment that would blur.) Hand-written and single-spaced typewritten essays will not be considered. All entries must be addressed to **Contest Editor, Instruments Publishing Co., 921 Ridge Ave., Pittsburgh 12, Pa.**

The Judges' ratings will be based upon: pertinency of factual data (closeness to the theme); value of information presented (breadth of applicability to problems faced by various industries); timeliness, novelty, originality, etc.; and effectiveness of presentation.

Manuscripts and illustrations become the property of the Sponsor and are not to be returned. The Sponsor reserves the right to publish any article submitted, whether prize-winner or not, and to exercise the privilege of editing each manuscript. Most will be published in *Instruments*; others—especially those of interest to specific industries, may be published in special-scope magazines. Due credit will be given to the author of any article which is published after the selections are made.

Contest closes Tuesday, January 31, 1950. All entries must be in the office of The Instruments Publishing Co. on or before that date. Don't forget that the envelopes must be addressed to "Contest Editor."

Every reader who knows of one or more ways of using instruments to cut costs is urged to enter the contest. The rules have been made easier than in our previous contests. It isn't as hard as you think! Read the rules and start preparing your entry—or entries!

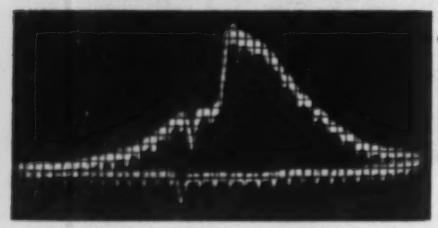

Illustration shows a Diesel engine performance curve. Ignition was about 8 degrees after top dead center. Peak pressure occurred 13 degrees after top dead center, thus angular position of crank is more favorable for efficiently converting pressure thrust into mechanical rotation. Small markers on curve are 5 degree indications, larger markers are top dead center.

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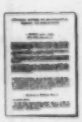
maintain a perfect pressure-time curve with the

SYNCRO-MARKER PRESSUREGRAPH

Instantly Shows whether you're firing on top dead center. Off-firing may mean broken piston rings, crankshafts, other damage. The Pressuregraph gives you a full detailed picture of the firing, of pressure variations, both regular and instantaneous. It measures pressure rise with time, accurately and precisely, from vacuum to 14,000 PSI.

The Pressuregraph provides oscillograph pictures which show relation of pressures to engine shaft rotation (top dead center), relation of pressures to time (milliseconds) or indications in degrees of rotation. Also applicable to gas, steam or hydraulic line measurement of static, dynamic or instantaneous pressures. Installation requires only threaded hole in region where pressure is to be checked.



TODAY . . . *Write For Booklet, "Electronic Methods For Measurement Of Pressure and Displacements"* ➤

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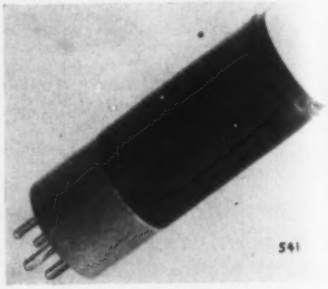
Sample holder accomodates 2 in. plates with space provided for absorbers. Holder for special dishes or crucibles may be ordered.—*N. Wood Counter Lab., 5646 Harper Ave., Chicago 37, Ill.*

Mention No. 1264 when filling out card.

Radiation Counter Tubes

New "Types 100 C, 100 N, 200 C and 200 N" end mica-window radiation

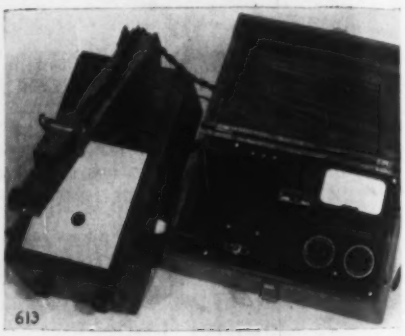


counter tubes are available in standard medium 4-pin bases for socket mounting; can be had in either regular construction or new 4-pin base.—*Amperex Electronic Corp., 25 Washington St., Brooklyn 1, N. Y.*

Mention No. 1265 when filling out card.

Radiation-detection Densitometer

New "Model 500-R Radiation Detection Densitometer" is specifically designed for monitoring harmful radiation in laboratories and factories where radioactive isotopes or other sources of radiation are handled. Monitoring is accomplished by periodic densitometric

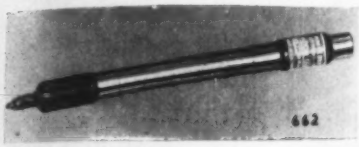


measurement of badge films worn by workers for a specific number of working hours. When developed film is inserted into Densitometer, amount of darkening (read directly in optical density) is a measure of time-integrated exposure in r units. Correlation depends on sensitivity of film being used. Densitometer's sensitivity permits reliable readings of less than 10 milliroentgens when most sensitive film available at present is used. Densitometer consists of two units: a densitometric illuminator with stabilized concentrated light source and swinging arm which carries phototube; and maker's electronic photometer. Operation: arm is lowered with an unexposed film intercepting light beam; needle is adjusted to density zero; unexposed film is replaced by exposed film; photometer then indicates optical density directly.—*Photovolt Corp., 95 Madison Ave., New York 16, N. Y.*

Mention No. 1266 when filling out card.

Radioactivity Counter Tube

New "Type 52 N" thin-metal-wall radiation counter tube for beta and gamma detection is self-quenching and features rugged mechanical construction, unlimited life, unchanging



characteristics with use, low operating voltage and a long plateau. Tube may be operated over a wide temperature range. Accidental overvoltage will not harm tube.—*Amperex Electronic Corp., 25 Washington St. Brooklyn 1, N. Y.*

Mention No. 1267 when filling out card.

Radiation Survey Meter

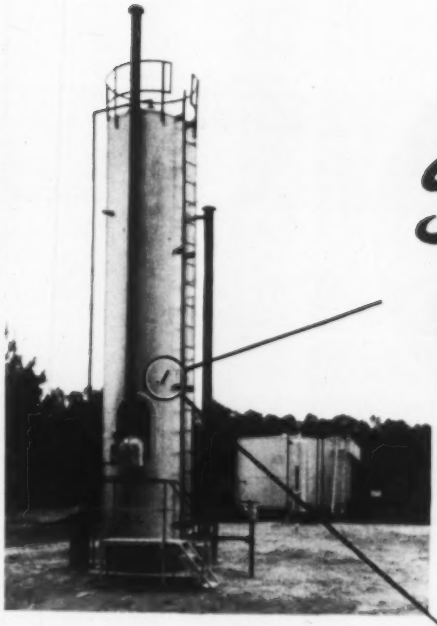
New "Model 263B" beta-gamma survey meter, modification of maker's "263A," was designed for semi-quantitative work, is highly sensitive to beta and gamma ray radiation. Full-scale sensitivity on three ranges is 130, 1300, and 13,000 counts per second. A

microammeter calibrated (with gamma rays from radium) in milliroentgens per hour, measures average radiation intensity. Counter tube is housed in a probe which mounts on outside of case and is capable of detecting individual ionizing particles. A movable shield on probe facilitates measurement of either beta and gamma rays, or gamma rays alone.—*Victoreen Instrument Co., 5806 Hough Ave., Cleveland, Ohio.*

Mention No. 1268 when filling out card.

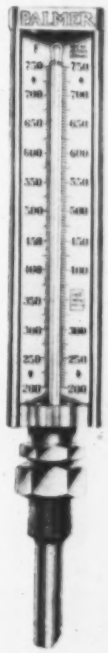
Radiation Detector

New "Models RD-1" and "RD-1A" radiation detectors use a rugged Geiger tube and low-priced batteries, and are



Small... but so important!

Above: An oil field oil-water emulsion treater, with Palmer Thermometers "on guard."



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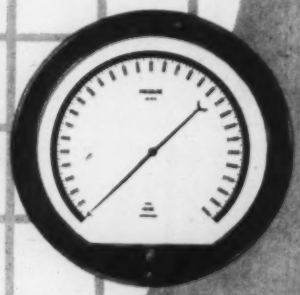

Heise pressure gauges employ an infinite number of Bourdon tube designs to reduce fibre stress to a point where the gauge can be used continuously at maximum calibration. There is no standard design. Every Heise Bourdon tube is designed for maximum stability and accuracy in a selected range and pressure medium.

Three sizes: 8½ in., 12 in., and 16 in., in ranges from 0-15 to 0-10,000 psi. Prices from $151.60 to $211.20. Write for catalog.

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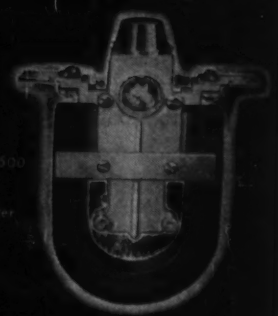

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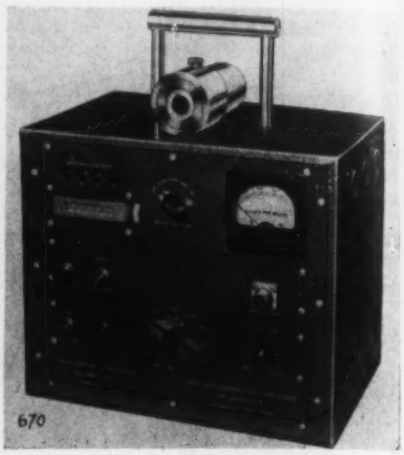
housed in a weather-proof case. Weight is about 2 lb. Counts are detected with earphones. "Model RD-1A" also has provision for visual detection with neon light. Instrument is in low-price class for prospecting.—*The Nucleonic Corporation of America*, 497 *Union St., Brooklyn* 31, *N. Y.*

Mention No. 1269 when filling out card.

Radiation Counters

New "Model RC-1" radiation counter includes both a scaling unit and a count-rate meter. "Model RC-1A" is a totalizing counter using a scaling circuit and a register. Scaling circuit may be had either as a binary or as a decade



scaler. "Model RC1B" uses a count-rate meter which makes it possible to follow changing intensities of radiation. Resolution time is variable from 2 to 50 microseconds. Features of a scale selector, pre-set time, and pre-set count are available. Provision is made for additional amplification so instruments can be used with proportional or with crystal-scintillation counters.—*The Nucleonic Corporation of America*, 497 *Union St., Brooklyn* 31, *N. Y.*

Mention No. 1270 when filling out card.

Mica-window Counter Tube

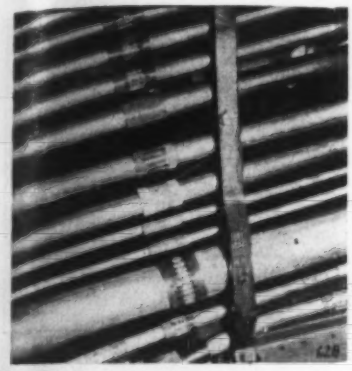
New "Model GM-1W" Geiger tubes are available with mica windows rang-

ing from 1 to 3 mg. per sq. cm. Window dia. is 1.125 in.—*The Nucleonic Corporation of America*, 497 *Union St., Brooklyn* 31, *N. Y.*

Mention No. 1271 when filling out card.

Plastic Identification Sleeve

New plastic sleeve which gives permanent identification to tubing, wires, conduits, etc., is made of cellulose-acetate-butyrate, approx. 0.013 in. thick, in extruded colors in code or plain patterns. Printing is resistant to normal abrasion, gasoline, alcohols,

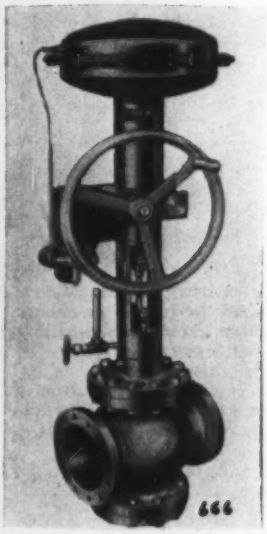


water, etc. In applying sleeve, operator snaps sleeve in place, dabs a small amount of bonding material to overlapped edge, and sleeve is bonded permanently.—*Topflight Tool Co., Inc., York, Penna.*

Mention No. 1272 when filling out card.

Continuously-connected Handwheel Valve

New continuously-connected handwheel-control valve eliminates necessity of conventional bypass installation. It is powerful enough to operate control valve manually, regardless of



maximum instrument air pressure on diaphragm or in opposition to spring. Travel limit stops limit valve stroke anywhere from 0 to 100 percent travel. Valve indicator shows valve plug position and setting of travel stops.—*Hammel-Dahl Co., 243 Richmond St., Providence 3, R. I.*

Mention No. 1273 when filling out card.

Instrument Nameplates

New engraved laminated plastic nameplates, for marking instruments, switches, instruction panels, etc., are made from laminated plastic sheets, 0.062 or 0.125 in. thick, having black, white or red faces with a contrasting-colored core. Letters and numerals are engraved through surface to bring out the contrasting color and obtain lifetime legibility. Nameplates are available with specified lettering in rectangular, circular, or irregular outline that will lie inside a 12 by 20-in. maximum

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The measurement and control of the sulfur content of natural gas is one of the important applications of the Titrilog, whether in connection with the purchase or sale of field gas, blending operations, the treating of high-sulfur gases, corrosion of lines and appliances, or odorization in distribution systems. For many of these applications, the Titrilog has been thoroughly field tested for over a year and its reliability and usefulness are well established.

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sistant materials are used throughout. —*Ross Operating Valve Co., 120 E.*

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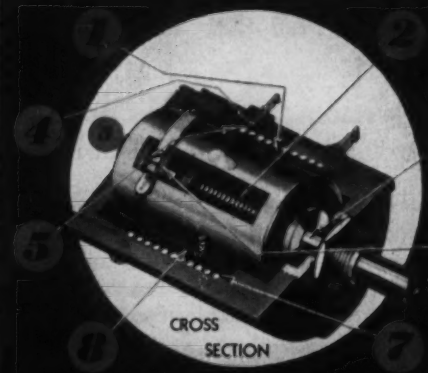

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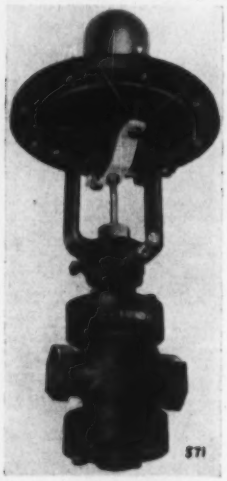
area. Letters can be 0.125 to 2.5 in. in height.—*Industrial Nameplate Service, P. O. Box* 5005, *Houston* 12, *Texas.*

Mention No. 1274 when filling out card.

Reversible Control Valve

New model of maker's "Stabilflo Valve" can be changed in a few minutes' time, and without use of special tools,



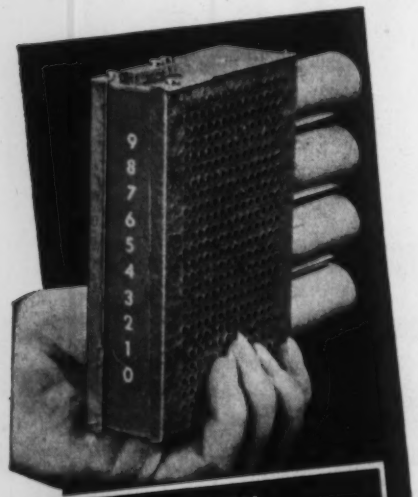
from air-to-open to air-to-close, or vice versa; and it is not necessary to remove valve from its installation or to shut down controlled flow. To reverse action of valve motor it is only necessary to remove the housing assembly, rotate it one quarter-turn, and replace it.—*The Foxboro Company, Foxboro, Mass.*

Mention No. 1275 when filling out card.

Solenoid Valve

New quick-operating solenoid air-control valve is 0.125 in. pipe size, straightway or 3-way, with in-line,

side, bottom or panel mountings. It is available in both normally-open and normally-closed models. Corrosion-re-



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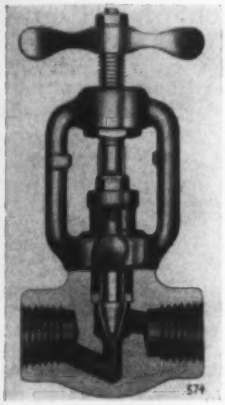
sistant materials are used throughout. —*Ross Operating Valve Co., 120 E. Golden Gate Ave., Detroit 3, Mich.*

Mention No. 1276 when filling out card.

Forged Steel Instrument Valves

New forged steel instrument valves are constructed of carbon steel, 13 percent chromium stainless steel, or 18-8 stainless steel, and are available in globe or angle design in 0.25 in., 0.375 in., and 0.5 in. sizes with screwed or socket welding ends. They have outside



screw and yoke construction; yoke is screwed onto body and tack welded. Carbon steel valves are rated at 1500 psi. at 850 F. and 13 percent chromium and 18-8 stainless steel designs are rated at 1500 psi. at 1000 F. WOG rating for all of these valves is 6000 psi. at 100 F.—*Edward Valves, Inc., East Chicago, Ind.*

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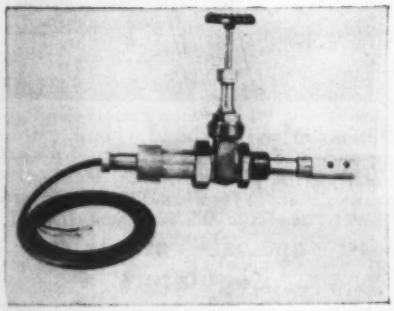
Removable Conductivity Cell

New insertion type conductivity cells with gate valve removal devices and range of cell constants from 0.01 to 2.0 can be obtained in Type 316 stainless



steel construction, as well as conventional bronze and brass, and are also available with built-in automatic temperature compensators.—*Industrial Instruments, Inc., 17 Pollock Avenue, Jersey City, N. J.*

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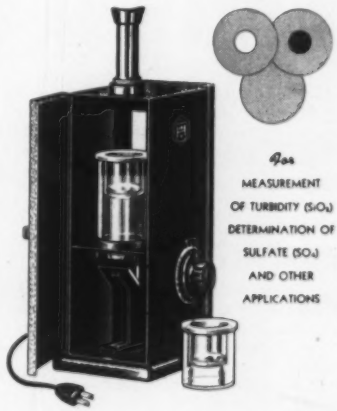

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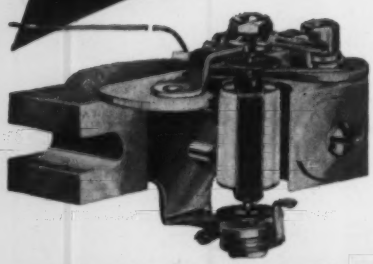

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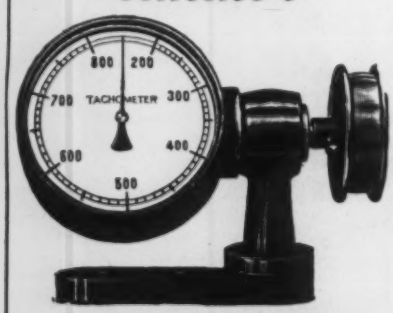

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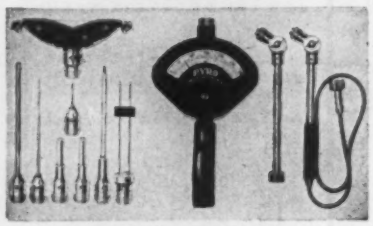

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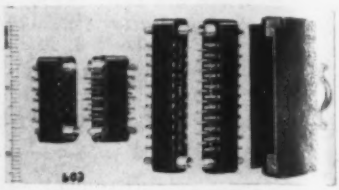


and polarization. Breakdown voltage: 5200 v.d.c., 3600 v.a.c.—*Dep't 1F, Winchester Electronics Co., 6 E. 46th St., N. Y. 17, N. Y.*

Mention No. 1279 when filling out card.

Mechanical Counter

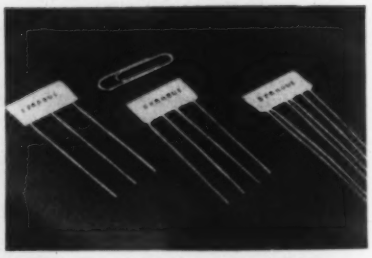
New "Model CS" counter features large-size figures and an integral case made of a single die casting. Both reset and non-reset models are stocked

in four-figure cases; and five and six-figure sizes are available. Counter is furnished for either clockwise or anti-clockwise rotation in standard 1:1 or special ratios and has a speed of 600 rpm.—*Durant Mfg. Co., 1914 N. Buffum St., Milwaukee 1, Wis.*

Mention No. 1280 when filling out card.

Ceramic Capacitors

New "Bulplate" ceramic capacitors are furnished with multiple capacitor



sections or with printed wiring, shielding and other printed details.—*Sprague Electric Co., North Adams, Mass.*

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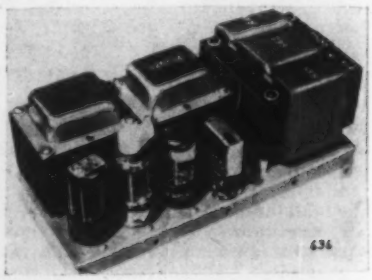
Special Voltage Regulators

New voltage regulators are adaptable to customer's specifications, particularly for use as components of an apparatus. An example is illustrated



unit from 0.35 to 0.05 ohms. Continu

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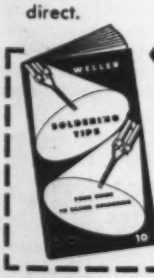

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model which measures 4 by 4 by 8 in. compared to standard model of same type which measures 6 by 8 by 9 in. —*Sorensen & Co., 375 Fairfield Ave., Stamford, Conn.*

Mention No. 1282 when filling out card.

Flaring Tool

New "Rol-Air" flaring tool flares and burnishes copper, brass and aluminum tubing; has three rollers embodied in spreader cone and is said to "roll flares in the air" because flares are not formed against a flaring block but rolled out with tubing extended

above face of flaring block. Thus, original wall thickness is maintained. After tubing is flared, it is burnished by turning operating handle two more revolutions with control knob in burnishing position.—*The Imperial Brass Mfg. Co., 1200 W. Harrison St., Chicago 7, Ill.*

Mention No. 1283 when filling out card.

Line-type Thermostated Heater for Gage-lines, Instruments, etc.

New "Thermwire" unit consists of an 80-ft. loop of insulated resistance wire welded at each end to a 10-ft. lead wire. A miniature preset thermostat is connected in center of loop. Power consumption (when "on") is 400 watts on 115 v. a.c. line. "Deluxe"

unit consists of two of above units with extra length lead, extra outlets, and overload circuit breaker. Units will prevent freezing of instruments or lines, and will draw current only when needed.—*Thermwire Co., Morris Plains, N. J.*

Mention No. 1284 when filling out card.

High Current Resistors

New "Bulletin 35 Edgeohm" resistors are now available in lengths of 6, 9.25, 12.5 and 15.75 in. as well as 19-in. length previously listed. New sizes extend minimum resistance value per

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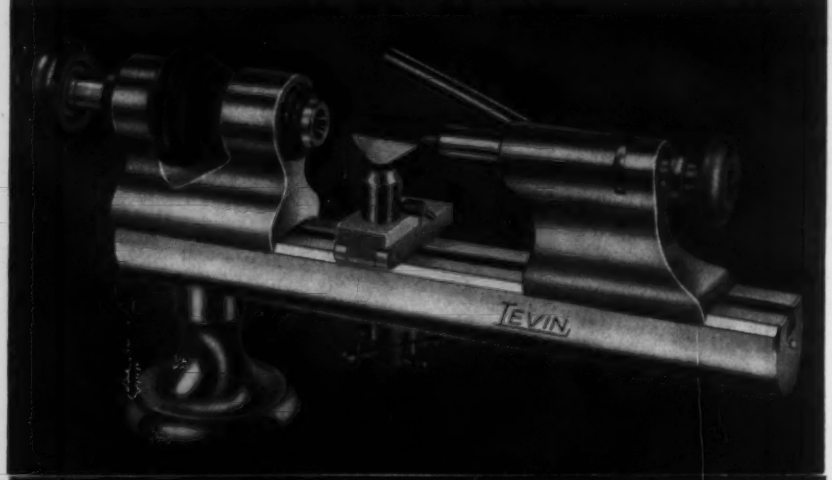

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unit from 0.35 to 0.05 ohms. Continuous current capacities range from 21 to 79 amperes for all sizes. Maximum continuous duty ratings are approx. 2200 watts for 19-in. units to 320 watts for 6-in. resistors.—*Ward Leonard Electric Co., Mount Vernon, N. Y.*

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Miniature Sockets

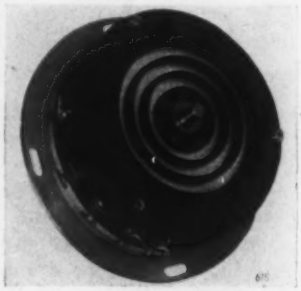
New 7-pin miniature tube sockets use molded "Mycalex" as an insulator. Sockets are obtainable in "Mycalex

410" which has lower loss factor than mica-filled phenolics, and in "Mycalex 410X" which has a loss factor of only about one-fourth that of Bakelite. Sockets fully meet RMA standards.—*Mycalex Tube Socket Corp., 30 Rockefeller Plaza, New York 20, N. Y.*

Mention No. 1286 when filling out card.

Differential Computing VDR

New "Type 748 Differential Computing Potentiometer" is designed primarily for applications requiring addition or subtraction of two variables in a single unit, with one voltage source. Uses include servomechanisms for computing or power amplification, direct replacement of two single VDRs when one is being used for compensation or correction purposes, etc. New



dual unit, through coin-silver precision slip rings in cover plate, will produce a net voltage sum or difference when one variable rotates shaft while another variable rotates body. Flange diameter 3.718 in.; guaranteed accuracy 0.1 percent; max. overall resistance (±10%) 150,000 ohms; elec. angle rotation 345.5±0.5 deg.; mechanical rotation, continuous: power dissipation 5 watts; torque 1 in-oz. max.; service life over 1,000,000 cycles.—*Fairchild Camera and Instrument Corp., 88-06 Van Wyck Blvd., Jamaica 1, N. Y.*

Mention No. 1287 when filling out card.

Electron Microscope Accessories

(1) New "EMN-1 Charge Neutralizer," designed to neutralize charges produced on diffraction specimens by primary electron beam of microscope, which may cause distortion of image, consists of a heated filament which sprays a low-velocity stream of electrons into diffraction specimen chamber. It is supplied with power supply which

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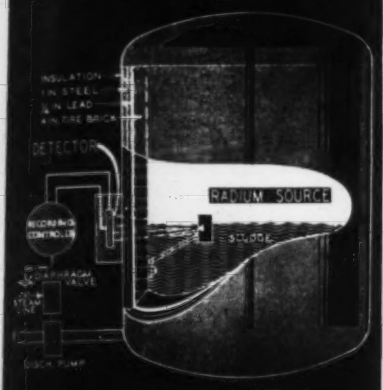

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operates from a 115-volt, 50- or 60-cps. a-c. line and draws approx. 60 watts.

(2) New "Type EMX-1 Focusing Magnifier" enables operator to focus upon a certain portion of image field with greater precision; permits direct viewing of image at 150,000 magnifications; consists of a 14-power micro-

scope mounted on a metal plate which may replace either of viewing chamber side windows, a small prism coated on upper face with fluorescent material, and a control handle to move prism into and out of electron beam path.

(3) New "Self-Bias Gun Kit, MI-12986," provides intense and controllable illumination with lower beam current; is interchangeable with zero-bias gun which is standard equipment for "Type EMU" electron microscope. —*Scientific Instrument Section, RCA Engineering Products Dept., Camden, N. J.*

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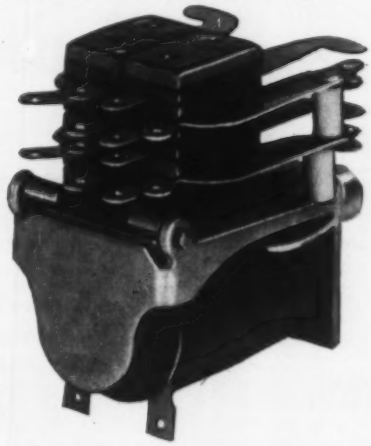
Optical Coatings

New "TRANSkote" fluoride coating remains undamaged under more than twice abrasion test standards set up under U. S. Government Specifications. Process results in a film of approx. same thickness as conventional fluoriding and affords approx. the same light penetration qualities.—*Pancro Mirrors Inc.*, 2958 *Los Feliz Blvd., Los Angeles* 26, *Calif.*

Mention No. 1289 when filling out card.

Miniature Relay

New "TKL" relay is available in contact combinations up to 4-p.dt. in either silver or palladium contacts. Contacts are rated at 1 amp. at 115 volts a.c. or 1 amp. at 32 volts d.c.



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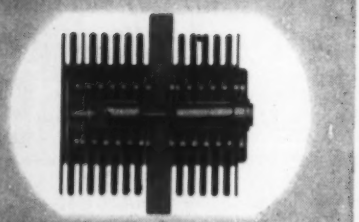

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noninductive. Coils can be supplied for any operating voltage up to 115 volts d.c. Relay is available in hermetically-sealed enclosures.—*American Relay & Controls, Inc., Chicago, Ill.*

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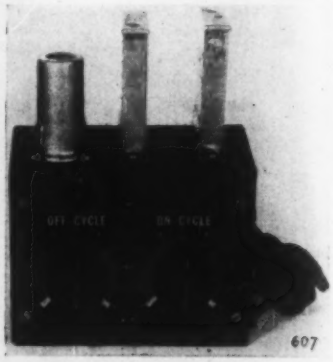
Electronic Timer

New "Cyclo-Flex" timer is of electronic type, uses one tube of radio type; may be operated either as single-cycle or as repeat cycle controller with two adjustable intervals. Single intervals can be varied from 0.5 to 3 sec. and repeaters from 0.5 to 3 and from 9 to 20 sec. Relay contacts are s-p.d-t. rated at 3 amp., 115 volts a.c. Overall dimensions in enclosed housing are 4 x 6 x 9 in.—*G. C. Wilson & Co., 2 N. Passiac Ave., Chatham, N. J.*



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Coated Filters for Photography

New "CT" color temperature filters include six bluish and six yellowish filters, to raise and lower color temperature by specified amounts. Filters are designed to correct for off-color illumination when taking color photographs or films. Cemented between optically-flat glass, and low-reflectance coated, filters are graded in even steps of 10, 20, 30, 40, 50 and 60, micro-reciprocal degrees Kelvin (the new unit being used by Eastman Kodak and others in dealing with color temperature). Tables cover use with all ordinary light sources, indoors and out.—*Photo Research Corp.* 127 *W. Alameda Ave., Burbank, Calif.*

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Pressure Switch

New pressure switch may be set to operate on heads from 6 in. to 14 in. and to reset on heads as low as 1.5 in. Designed for specific pressures, it is unaffected by turbulence and mechanical vibration and is furnished in two basic types—for fixed or variable levels. Unit will withstand moderate

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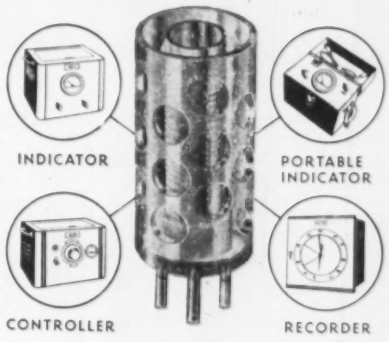
Cereal Chemistry, March, 1949, p. 166.

ELECTRIC HYGROMETER



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Measures accurately within plus-minus 1½% relative humidity, without periodic attention.

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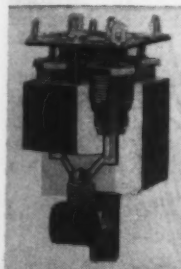

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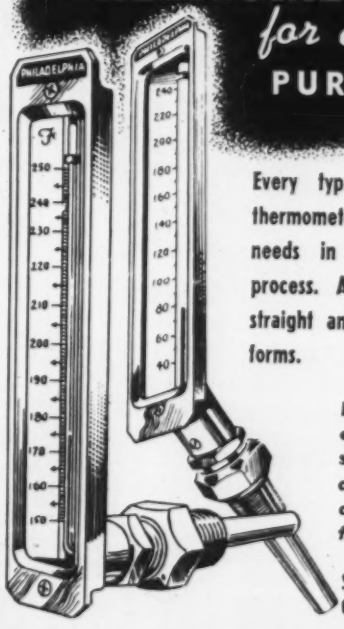

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overload pressure and vacuum. Calibration is said to be stable over thousands of operations. Actuating force is transmitted by diaphragm and pressure plate to s-p. d-t. snap action switch rated at 6 amps, 125 volts a.c., inductive load.—*Soreng Mfg. Corp., 9555 Eden Ave., Schiller Park,*

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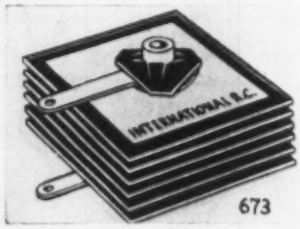
Miniature Selenium Rectifiers

New line of high voltage selenium miniature rectifiers is announced. Units consist of six individually tested and



matched cells connected in a half-wave circuit and rated at a maximum peak inverse voltage of 380 volts. Current ratings which are available are: 75 ma., 100 ma., 150 ma., 200 ma., 250 ma., 300 ma., and 350 ma.—*International Rectifier Corp., 6809 So. Victoria Ave., Los Angeles 43, Calif.*

Mention No. 1294 when filling out card.

Grid-controlled Rectifiers

New "AGR-9950/5869" and "AGR-9951/5870" grid-controlled mercury-vapor rectifier tubes have a maximum peak anode voltage of 13,000 and 21,000 respectively. Filament-heating time is two minutes. In a single-phase, full-wave rectifier the first will deliver an average current of 2 amp. and the second, 5 amp.—*Amperex Electronic Corp., 25 Washington St., Brooklyn 1, N. Y.*

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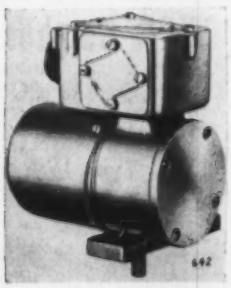
Power Unit

New rotary actuator can be controlled by inching switch, positioning rheostat, or by an automatic temperature-sensitive bridge circuit. Powered by a 26-volt 1.5-amp. d-c permanent-magnet motor, unit has a max. torque of



50 lb.-in. and a max. travel of 300 degrees. Cam-operated limit switches are accessible for adjustment of actuator travel before and after installation. Rigid mounting is provided by two drilled flange pads. Weight, 14 oz.—*Barber-Colman Company, Rockford, Ill.*

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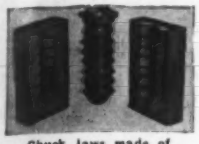
with CERRO ALLOYS



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Regulation of pH

Continued from page 1107

onto following process units. There are at least two unhappy incidents of the writer's early experience which led to the development of an approximation to be described.

The derivation of an approximate guide requires quantitative data on at least three variables which have bearing on regulation.

(a) The chemical nature of the process as defined by the acidity characteristic.

(b) pH load variations.

(c) Detection lags, inclusive of process and transmission lags.

The magnitude and frequency of load changes have an important bearing and, for the purpose of discussion, we will assume a maximum instantaneous load change of 30 percent. Process lag depends on the residence effect of the system and on its throughput rate. If this varies because of level changes in the retention tank or changes in throughput rate, the derivation will be invalidated and, for the purpose of discussion, we must assume constant residence and throughput. We will select a tank of 900 gallons capacity and a throughput of 450 gpm. Detection lag and transfer lags can be measured directly or estimated from Fig. 45 and we will assume a value of 30 seconds for this effect. We will also select a caustic neutralization process using sulphuric acid reagent to control at 7.3 pH.

Having established the conditions of our problem, it is necessary to determine the acidity characteristic of the liquor (see Figs. 4, 9, 11, etc.) using reagent control acid and plotting the data as a percentage deviation curve at and near the desired control point as in Fig. 77. Next, the effective process lag must be determined from a family of

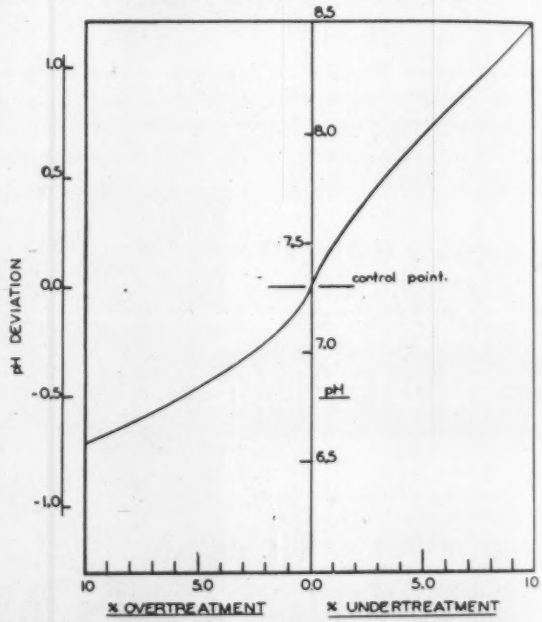

Fig. 77. Deviation characteristic of pH control process used for graphical determination of throttling-range adjustment.

standard residence curves which describe the rinse-out characteristics of a residence system. For the sake of our derivation, we will refer to Fig. 78 which applies specifically to the retention specified.

We have assumed a load change of 30 percent normal and, since the system has a total detection lag of 30 seconds, this load change will prevail throughout that period. Therefore, by reference to Fig. 78 we find that in 30 seconds time the concentration of caustic will have built up to 20 percent of the original 30 percent load change, or 6 percent. By reference to Fig. 77 we find that an increase of 6 percent caustic content corresponds to a pH of 8.1, or a deviation from the control point of 0.8 pH. We could select additional points from Fig. 78 for different time intervals and obtain a plot of pH deviation versus time. However, for this problem we my select the ratio of 30 percent load increase

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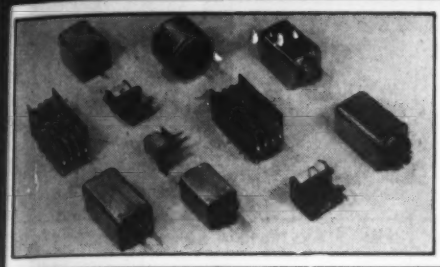

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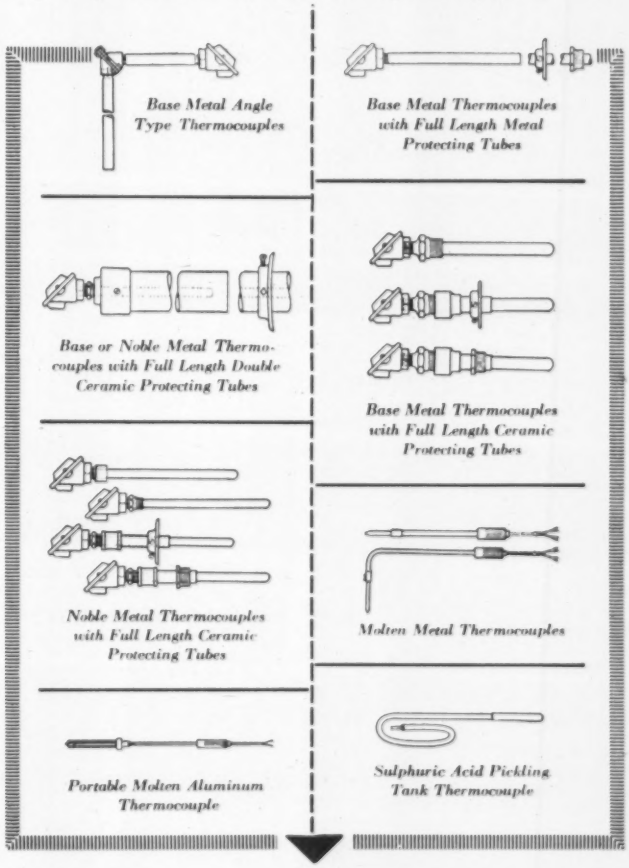
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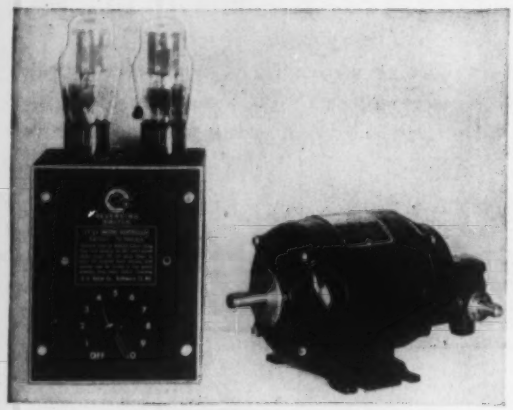

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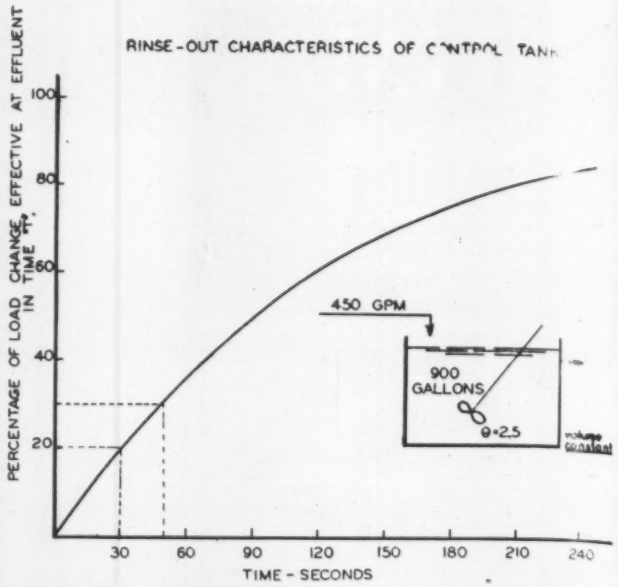

Fig. 78. Rinse-out characteristics of pH control tank, useful in determination of optimum throttling-range adjustments.

to 0.8 pH change as a measure of the desired throttling action of the regulator, and assume that a 30 percent increase in acid feed is required to offset the load.

If the original valve position was 50 percent open and a 30 percent increase were required, it would throttle to a new position of 65 percent open to compensate the instantaneous load. 30 percent of 50 percent opening corresponds to a 15 percent change of full valve travel, or 0.8 pH change. The resultant change in pH corresponds to 8.0 percent of full scale (Recorder, range, 2.0 to 12 pH). Therefore,

$$(8 \times 100)/15 = 53 \text{ percent throttling range.}$$

It must be borne in mind that this is *not* an exact derivation and is intended only as a rough guide for initial settings of proportional band during critical start-up perods. A more exact approach is more involved and is more useful as a design tool rather than a rapid spot check. Many simplifying assumptions have been made but all are not additive in one direction.

First, it was assumed that the acidity characteristic is uniform on both sides of the control point and that a 30 percent load change requires a 30 percent change in reagent feed. Actually, the increased reagent requirements depend upon reagent strength but the exact percentage demand can be interpreted from the acidity characteristic. However, to apply this data, an exact knowledge of valve flow characteristics is required and this is not easy to obtain in the field except by reference to experimental tables. Furthermore, if the acidity characteristic is not uniform on both sides of the control point, the derivation should be based on that portion exhibiting the lowest buffer index.

Assumptions were also made regarding the relationship of detection lag and residence rinse-out. Actually, the recorder will not see the total change represented at the effluent in the detection lag period and there will always exist an "out-of-phase" relationship so long as the residence change and electrode detection lags are additive. This can be minimized by use of submersible electrodes, but it is more effectively compensated by superimposed derivative action in the regulator.

The writer has applied this guide to a number of control installations without mishap or serious cycling resulting from improper regulator adjustments. It is normally preferred to start-up a pH controller with low regulator sensitivity (wide proportional band) and, once accustomed to this practice, one may be inclined to lack faith in an initially high sensitivity setting. As a matter of experience, the writer has found that final adjustments were, for the most part, set at a higher throttling range than indicated by the rough guide although many required opposite adjustment. Estimated adjustments have shown least

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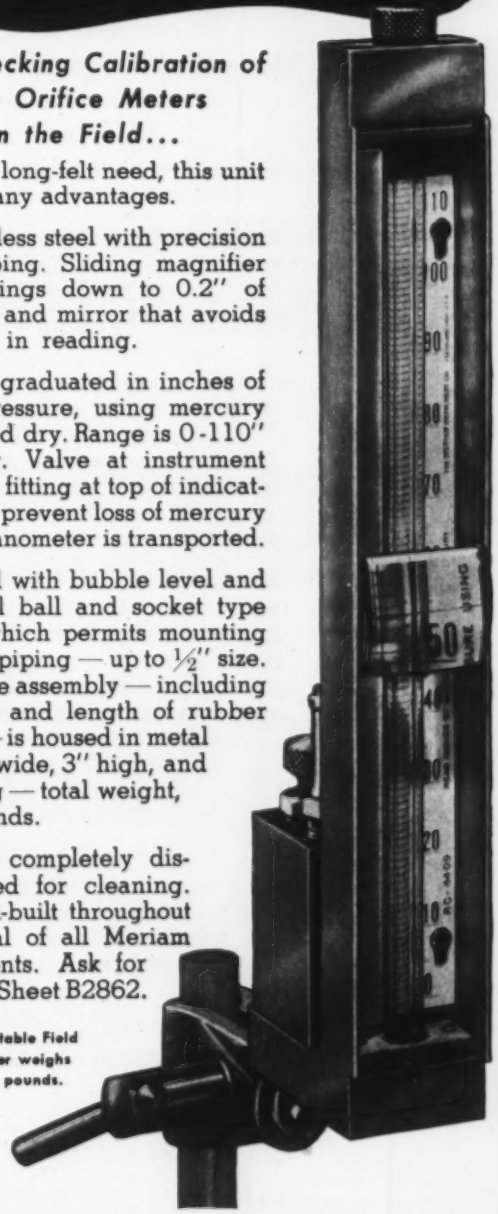

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divergence from actual setting when buffer index of the process is relatively low, sigma=1.0 or below.

It must be borne in mind that the combined effects of low residence and large detection lags of a process have unstabilizing action on a proportional regulator; and that adjustments made for one load value may not be valid for another, particularly if buffer index is high. If the detection lag is excessive or a distance-velocity component is added to the controller circuit which does not exist in the process (e.g., electrodes located at a remote distance) the reaction rates of process and regulator will not be in concordance at all pH loads.

This deficiency of a proportional regulator has been overcome to a large degree by derivative regulators which operate in a manner to arrest the residence effect and prevent concentration in the system from building up to the value it normally would have in the time representative of detec tion lag of the regulator.

Derivative regulators have, in many cases, been a blessing to the control engineer, especially in connection with pH and other similar *concentration* control problems having high reaction rates in a system of slow transfer (high detection lag). They permit more beneficial use of residence than is possible with proportional regulators. They *control* the residence, whereas the reverse is usually true with a proportional regulator.

Residence is an extremely valuable tool to reduce rate changes in a process but, unless controlled, it may introduce an unstabilizing action by virtue of its exponential relationship between time and concentration: The rate of change of residence varies with time.

A proportional regulator has little effective control over the residence and it allows the effluent concentration to fluctuate over a broader range of the residence characteristic than does the derivative regulator. The derivative regulator is more effective in arresting effluent concentration changes since it tends to restore inventory of the residence to fixed concentration in shorter time, thus preventing serious changes in rate-response of the process. It accomplishes this by measuring rate change at the electrodes and adding reagent at a sufficient rate to arrest the oncoming changes stored in the residence. The derivative regulator has been applied very effectively as a pH control on processes having delayed residence reaction, but it must be applied with caution to non-reversible reactions and liquors which are subject to "burning" or localized overtreatment.

In closing this section, the importance of cascaded regulators in pH control cannot be overstressed. The characteristics of the pH variable are non-linear; and ra response is usually far beyond the reaction rate of conventional regulators. Turn-down requirements, in terms of equivalents of reacting chemicals, are very high compared to the more simple process control quantities, and the limitations of unit regulators in this respect impose a limiting condition on the behavior of a given process. If reagent is diluted to obtain more stabilized control action, one may do so at a sacrifice of control rangeability. An increase in reagent concentration for added rangeability results in an increase of process rate response and greater divergence in rate behavior of process and regulator. If the regulator is limited in reaction rate, the limitation of turn-down can only be compensated by adding inertia to the process to retard its reaction rate as required by the limiting regulator.

A single regulator cannot compensate for the effects of all conditions involved in many processes which effect a change in pH, at the rate at which changes occur. It is most advantageous, therefore, to analyze the process in terms of all variables which may cause a change in pH, and apply a system of cascaded regulators in such a way that one unit regulator must compensate for possible variations in only one condition. For example, if throughput rate and acidity load are both subject to change, the flow should be measured and ratioed with reagent flow; and, likewise, cascaded with a pH controller which compensates for variations in pH load. Furthermore, if pH load is greater than the limitations of a single regulator, the problem may call for a division of the load between two pH regulators, one of which acts as a "pre-act" controller for the second. Or the process should be designed to incorporate multi-stage residence control with flow-ratio and pH reset on the first stage, and unit pH regulation on the second stage.

If reagent strength is subject to variations, this is a most serious limitation to good regulation; and, if such variations must be accepted, it may be advisable to cascade the pH controller with another regulator which compensates, in some way, for such variations. Variations in liquid level of the control tank may affect control and should be compensated by cascading.

Other examples might be given of many conditions which contribute to load changes, but the important thing to bear in mind is that each condition contributes additively and should be compensated independently. A pH process is extremely more rapid in response to a control signal than a corresponding temperature process and its response is non-linear. It is quite impractical to build a single regulator whose reaction rate and performance characteristics are equal to the theoretical requirements of many processes, and one must accept this condition as a limitation to the application of available industrial equipment.

To be continued

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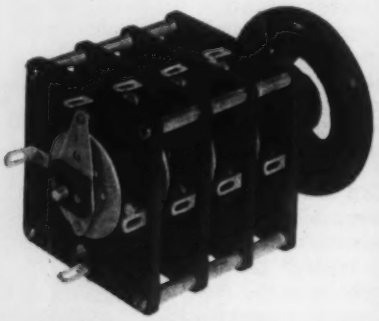

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SPECTROSCOPY CONFERENCE

The Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy will be held at the William Penn Hotel, Pittsburgh, Pennsylvania on February 15, 16 and 17, 1950.

The Conference is being jointly sponsored by the Analytical Division of the Pittsburgh Section of the ACS and the Spectrographic Society of Pittsburgh.

An Exposition of Modern Analytical Equipment will be featured at the Conference.

—GEORGE W. KELCH, *Chairman*
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SOCIETY FOR APPLIED SPECTROSCOPY

The January meeting of the Society for Applied Spectroscopy will be held on Tuesday, January 10, at 6:00 p.m. Informal Dinner, Tosca's, 118 Fulton St., New York City. No Reservation necessary. Meeting at 8, p.m., at Socony-Vacuum Training Center, 63 Park Row, New York. Speaker, Dr. Daniel Norman, New England Spectrochemical Laboratories. Subject, Spectrographic Analysis of Molecular Fragments. Technical Chairman, Robert Taylor, Atlantic Refining Co.

—RODGER W. LOOFBOUROW

JOURNAL of the
Instrument Society of America

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Vol. 5 DECEMBER 1949 No. 12

St. Louis Show On Sound Film

ISA members will soon be able to sit comfortably with their friends at one of their regular Section Meetings and have the wonders of color photography bring the St. Louis Exhibit to them. Some fifty exhibits have been permanently recorded on film, and the fifty exhibitors have carefully prepared accompanying sound scripts to introduce the outstanding instruments on display in their booths.

The films provide the opportunity for those members who were unable to attend the show (and for those who did go, but did not see all they wished to) to tour the exhibit and hear directly from the exhibitor.

35 mm color slides have been grouped into three groups of slides, each group with its accompanying sound tape recording to run for 30 minutes.

Film No. 1 includes: Aircraft Marine Products, Inc.; Automatic Electric Sales Corp.; Barton Instrument Co.; Bristol Co.; Buffalo Meter Co.; Century Geophysical Corp.; Climax Engineering Co., Controls Division; Consolidated Engineering Corp.; R. W. Cramer Co.; Davis Emergency Equipment Co.; Engineers Specialties Division, Universal Engraving & Colorplate Co., Inc.; Claud S. Gordon Co.; Gormac Products, Inc.; Gow-Mac Instrument Co.; Hammel Dahl Co.; Helicoid Gage Div.; American Chain and Cable Co.; Instruments Publishing Co.; and Leslie Co.

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Film No. 3 includes: American Meter Co.; Annin Co.; Bailey Meter Co.; Arnold O. Beckman, Inc.; Brooks Rotameter Co.; General Electric Co.; Heiland Research Corp.; Illinois Testing Laboratories, Inc.; Nash Engineering Corp.; North American Phillips Co.; Panellit, Inc.; and Trinity Equipment Corp.

Film No. 3 is still in the assembly stage, but completion is expected by January 1.

Three complete tours are available on loan from the National Office. Section Secretaries may borrow the films by writing to the National Office and requesting a film loan form. The sound slides are also available to all Sections of the cooperating Societies.

The complete tour will require a showing time of one and one-half hours. It is suggested that Sections schedule one film per meeting night, the entire tour to run three meeting nights.

NCIA Affiliates with ISA

The Northern California Instrument Association formally became the Northern California Section of the Instrument Society of America on November 21. Dr. A. O. Beckman, National Vice-President of the ISA, presented the Section charter to Mr. C. S. Beard of Bechtel Corporation, President of NCIA.

A panel discussion "Fractionation Column Control," with J. O. Shenk, Bechtel Corporation, as moderator, followed the charter presentation. Hugh Rodman, Sales Representative, Jerome Kohl of Tracer Laboratories, C. L. Hughes of California Research Corporation, Dr. Ott Smith of the University of California, and G. B. Zimmerman of Bechtel Corporation were members of the panel.

In addition to Mr. Beard, the officers and board members include Keith Drager, Standard Oil Company of California, Vice-President; M. A. Dimmick, Mare Island Navy Yard, Secretary-Treasurer; D. J. Pompeo, Shell Development Company, Past President; P. A. Gibbon, Shell Development Company, Program Chairman; Marshall Caley, United Air Lines, Membership Chairman; B. S. Truett, American Meter Company, Education Chairman; W. C. Marion, Alameda Naval Air Station, Constitution and By-Laws Chairman; and G. T. Bowman, Rockwell Manufacturing Company, Publicity Chairman.

ISA Lapel Buttons and Tie Chains

Lapel buttons for members of the Instrument Society of America may be obtained from National Office, 921 Ridge Avenue, Pittsburgh 12, Pa.

The gold-filled buttons, attractively designed in the shape of the official ISA emblem, are inlaid with white enamel and are approximately one-half inch high. The price is $1.50 each.

A tie-clasp and chain with an ISA emblem on a key is also available. The emblem is identical to that on the lapel button. The clasp, gold-filled, is priced at $5.00.

New York Section Holds Midwinter Meeting

"Modern Temperature Instruments and Measurements" will be the theme of the New York Section's third special midwinter meeting scheduled for January 27 and 28 at the Hotel Statler in New York City.

Two technical sessions will be held Friday, January 27, followed by a dinner in the evening. Chairman of the afternoon session will be ISA past President, Professor Carl F. Kayan, Department of Mechanical Engineering, Columbia University. The Friday program follows:

8:45 A.M.—Registration.
9:30 A.M.—Technical Session: "Temperature Measurement by Gas Flow Methods," W. A. Wildhack, National Bureau of Standards. "Theory and Utilization of Bimetallic Temperature Elements," E. R. Kebbon, Weston Electric Instrument Corp. "Action of Air Operated Controllers," O. C. Fairchild, Consultant.
12:30 P.M.—Adjournment for Lunch.
2:00 P.M.—Technical Session: "High Temperature Pyrometry," J. Ward Percy, U. S. Steel. "Special Problems of High Temperature Gas Measurement," (Speaker to be announced). "Electronic Bridge Circuits for Temperature Measurement," F. L. Maltby, Bristol Company.
8:00 P.M.—Dinner.

Two technical sessions will be held on Saturday. A. K. Joecks will be chairman of the program which will deal with maintenance of industrial and scientific temperature instruments, including the service, test, repair and recalibration of temperature instruments. Descriptions and demonstrations will be conducted. Saturday registration and session times are the same as on Friday.

Hotel accommodations may be obtained at the Hotel Statler. Members of other ISA Sections are especially welcome. Correspondence should be directed to the New York Section Secretary, Norman J. Cherry, Box 608, Merrick, L. I., New York.

Obituary

It is with regret that we announce the death of Thomas M. Hunt who passed away suddenly on Thursday morning October 13th. Mr. Hunt was a charter member of the South Texas Section, had served as vice president one term, and was an active participant in Section activities.

Instrument Personnel Training Program In A Modern Chemical Plant

By ROLLIN H. BRIGGS†

THIS paper is being presented to describe an established training course and qualifications for instrument men in the hope that it may assist the development of adequate training courses for the Instrument employee in industry.

Employees selected for instrument work are invariably natural mechanics and have an aptitude for working on more or less intricate mechanisms. Industrial instruments offer a broad field for these aptitudes. The training of these men in industrial instruments has been met by establishing a within-plant training program described in the following sections. Many companies are desirous of establishing training programs for their instrument men; to this end The Instrument Society of America hopes to be of assistance.

There are six classifications of Instrument men in our organization. In order of increasing responsibility, these classifications are: (1) Instrument Helper; (2) Senior Instrument Helper, Class I; (3) Senior Instrument Helper, Class II; (4) Senior Instrument Helper, Class III; (5) Journeyman Instrument Man; Journeyman pH Man; Journeyman Watchmaker; Instrument Calibrationist; and (6) Instrument Technician.

To be considered for the starting position as an Instrument Helper, an applicant must possess the following qualifications: Be a high school graduate or have equivalent education, be in good physical health and have a congenial personality and natural ability for instrument work. An applicant must also pass an aptitude test with a grade of 75% or better. The aptitude test consists of problems in electricity, scales and meter reading, drawing and sketching, arithmetic, algebra, geometry, mechanics and science. An Otis test is also given as a secondary check and a test of the applicant's general knowledge and I.Q. Applicants who receive a satisfactory grade on these aptitude tests and who are favorably considered by the Employment Department are interviewed by the Instrument Department Supervisor and Instrument Engineer. Selection of the Instrument Helper is made by comparing the merits of all the applicants. About 10% of those applying for Instrument jobs are employed as Instrument Helpers.

During the first twelve months of employment an Instrument Helper may be assigned work in the instrument parts division, pressure gauge repair, general shop repair, or field work as a helper to Journeymen Instrument men or Instrument Technicians or as directed.

During this period the Instrument Helper works and receives instructions in the various shop jobs, with the shop Journeyman Instrument Man repairing all types of meters and controllers. He works with the Instrument Calibration Man repairing voltmeters, ammeters, watthour meters, pyrometers and potentiometers. He also works with the Watchmaker on the repair of watches, clocks, timers, balances and engraving machine operation.

The Instrument Helper's field training consists of a period with the Instrument Technician, assisting in installing single instruments, or complete panel jobs, checking and placing the instruments in operation.

During the second six months of the first year of employment an Instrument Helper is given a review course consisting of two-one and one half hour class periods a week, on company time, covering the following subjects: Fractions and decimals, algebraic equations, powers and roots, ratio and proportion, geometry of the right triangle, trigonometry of the right triangle; physics of heat, Centigrade, Fahrenheit and absolute temperature; vacuum, absolute and gauge pressure; hydraulics of liquid flow; Ohm's law, Kirchhoff's laws, series and parallel resistances.

During this review course the Instrument Helper is expected to spend the necessary study time at home to complete his assignments. Every two weeks a periodic test is given covering the work during that period and at the completion of a six months period the trainee is required to pass a written final examination on the work covered during the course. The Instrument Helper must also have the following qualifications: Must be punctual, must be a good, neat, careful and safe worker, must show initiative, must demonstrate his ability to learn and must be responsive to orders. He must have mechanical ability, must know the use and care of tools as used in the department, must know the importance of precision as applied to instruments, must understand simple electrical circuits and fundamentals of electricity. He must be able to identify, make, and weld thermocouples, must be able to work in the instrument shop or as helper to the Journeyman Instrument men or Instrument Technicians, or as directed. An Instrument Helper must also be able to change charts and ink recorders and be able to calibrate pressure gauges either by comparison to a secondary standard or by dead weight tester.

A rigid schedule is kept on all Instrument Helpers in order to be sure each employee has the same opportunity to work at each of the jobs available to complete his training.

If at the end of the Instrument Help-

Fig. 1. Instrument shop showing instrument office in the right background and the instrument parts room in the left background. Adequate lighting, ventilation and work space is essential.

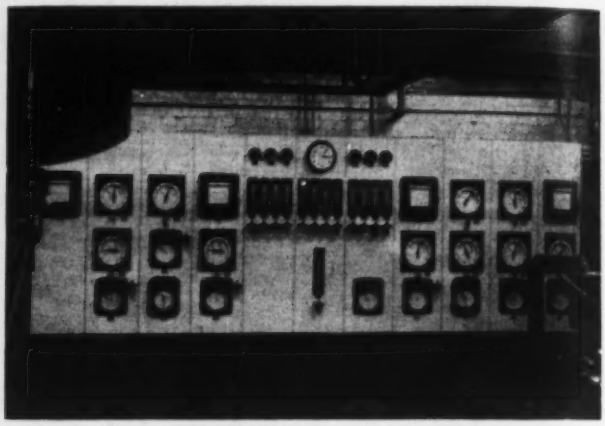

Fig. 2. Instrument Helpers and Senior Instrument Helpers assist in the installation and maintenance of instrument panels as part of their regular training.

Fig. 3. Laboratory experiment demonstrating the calibration of a thermocouple using an ice bath for the reference junction.

*Presented at the Fourth Annual Conference of the Instrument Society of America, Sept. 12-16, 1949, St. Louis, Mo.

†Instrument Department Supervisor, Dow Chemical Company, Midland, Mich.

er period of twelve months an Instrument Helper has passed the practical and written examinations on the above review course, and if he has satisfactorily demonstrated that he has the above qualifications, if he has been classified as an Instrument Helper for twelve months, if he has worked at least ninety-five per cent of the working hours during this period, excluding vacations, he is eligible to be promoted to the Senior Helper I classification.

If an Instrument Helper has not satisfactorily demonstrated that he has the qualifications as stated above, he is given a period not to exceed thirty days in which to locate another job. At the end of this thirty day period he is released to the Employment Department.

After an employee has satisfactorily fulfilled all the requirements of Instrument Helper as outlined, he is advanced to Senior Instrument Helper, Class I. During this six months period the employee is given a five week training course consisting of fifteen lessons in "Problems in Blue Print Reading." This course is designed to effectively teach blue print reading without passing through the intermediate stage of drawing. The course consists of three-view drawings of more or less familiar machine parts and usually six questions pertaining to each drawing. These consist of filling in the missing dimensions, identifying lines and surfaces on all three views, etc. Space is also provided for the student to make a free hand sketch of the object under study, including changes as instructed. Thirty-three problems are worked in the text which consists of a little more than two problems per class period to complete the course.

Standard symbols as adopted by our Engineering Department are also covered so that the student is familiar with the conventional techniques for the exchange of ideas. The student is graded 40% on the problems and questions, 40% on accuracy of sketching and 20% on neatness of the work.

The next course constitutes the beginning of the formal training in industrial instruments and consists of three- one and one half hour classes per week for twenty-one weeks covering the following subjects: Standards of measurements, pressure and vacuum gauges, indicating and recording bulb type thermometers, and thermoelectric pyrometry. This is supplemented by frequent laboratory experiments demonstrating the principle of each type of instrument. Periodic tests are given during the course and a written final examination is given at the end of the course and must be passed before the employee can qualify for further promotion. The following qualifications must also be exhibited: ability to read simple blue prints, ability to order materials from stock, knowledge of the use and care of simple test equipment, knowledge of names of equipment and materials commonly associated with instruments and controls, ability to identify thermocouples and thermocouple lead wire, ability to change charts, ink, clean and oil recording instruments, and the ability to provide routine maintenance for indicating and recording pressure type thermometers, indicating and recording pressure gauges, simple pressure controllers and orifice flowmeters.

Upon passage of the written examination on the class work and a favorable exhibition of the above qualities, the employee is promoted to Senior Instrument Helper, Class II.

The training course continues for the second twenty-six weeks period for employees promoted to the Senior Instrument Helper Class II classification, covering the following subjects: high temperature pyrometry, including pyrometers, potentiometers, resistance thermometers, optical and radiation pyrometers, also differential pressure type flow meters, volumetric type flowmeters, liquid level, and telemetering.

During this period the employee must exhibit the following qualifications: ability to read blue prints and follow simple wiring diagrams, ability to change charts, ink, clean, oil and make minor adjustments to recording instruments, ability to do routine maintenance on indicating, recording and controlling pressure type thermometers, resistance thermometers, millivoltmeter type pyrometers, thermocouple potentiometer pyrometers, optical and radiation pyrometers, orifice type flowmeters, rotameters, electrical meters, vacuum tube circuits, and liquid level controllers.

Providing a written examination is passed and the above qualifications are

FORM A

THE DOW CHEMICAL COMPANY

MAINTENANCE DEPARTMENT RATING FOR HELPERS AND SENIOR HELPERS

Name _____ Department _____

Rating Period: From _____ To _____ Days Absent (Optional) _____

Return this form to Maintenance Educational Department by _____ Score _____

(Instructions on Reverse Side)

REQUIREMENTS	SATISFACTORY — HOW DOES HE MEASURE UP TO THESE REQUIREMENTS?		UNSATISFACTORY
1. A satisfactory day's work.	Rapid worker. Usually did more work than required.	Steady worker. Completed jobs with little wasted time.	Wasted too much time; lazy; slow.
2. Ability to perform jobs assigned.	Showed unusual ability in carrying out work assigned.	Demonstrated ability to satisfactorily carry out work assigned.	Lacked ability to satisfactorily carry out work assigned.
3. Judgment	Excellent thinker. Decisions sound in all situations.	Used common sense. Decisions usually sound.	Illogical thinker. Decisions unsound.
4. Dependability	Required very little supervision.	Required normal supervision.	Required more supervision than necessary.
5. Cooperation and attitude.	Inspired good teamwork. Attitude excellent.	Obliging. Willing. Worked well with others.	Troublesome. Attitude poor. Upset morale.
6. Initiative and job interest.	Tackled jobs eagerly and enthusiastically. Continuous drive.	Tried hard. Conscientious. Drive and enthusiasm good.	Listless. Lackadaisical. No drive. No enthusiasm.
7. Cleanliness	Always practiced cleanliness in work. Left jobs in excellent order.	Neat worker. Left jobs in good order.	Often neglected to clean up jobs in good order.
8. Safety	Consistently used safe practices.	Generally used safe practices.	Indifferent to safe practices.
9. Direction of others. (RATE ONLY WHEN APPLIES)	Unusually successful in directing others.	Effectively directed others.	Did not effectively direct others.
10. Planning for material transportation, job layout and work of men. (RATE ONLY WHEN APPLIES)	Planning exceptionally thorough and complete.	Planned job satisfactorily.	Planning poor.

REMARKS: _____ RATED BY: _____

DATE: _____

TRAINER'S SIGNATURE _____

BE SURE YOU CAN JUSTIFY THIS RATING

INSTRUCTIONS

1. Rate each helper and senior helper once every TWO WEEKS as long as all requirements are rated "Satisfactory".
2. If any requirement is rated as "Unsatisfactory", make a rating once EVERY WEEK thereafter until all requirements are "Satisfactory". Then rate once every TWO WEEKS.
3. Check one box only for each requirement.
4. Every man should be permitted to see his own rating.
5. All unsatisfactory ratings should be reviewed by shop supervision, and discussed with the man rated.
6. It is recommended that in case of unsatisfactory ratings, the trainee sign the rating sheet.
7. Forward completed rating to Maintenance Educational Department on date indicated. A complete report on each man will be returned to the shop once each month.

Fig. 4. Form used for grading Instrument Helpers and Senior Instrument Helpers on their practical work. (Front of form above, back below)

Fig. 5. A class of Senior Instrument Helpers discussing the principles of automatic control mechanisms.

Fig. 6. Visual aids are used in conjunction with training courses. Projectors for 16 mm. sound film, vocal films, 2" x 2" color slides and standard slides are shown.

met, the employee is promoted to the next classification of Senior Instrument Helper, Class III.

Employees promoted to Senior Instrument Helper, Class III continue their formal training for a third twenty-six weeks period, covering the subjects of automatic control theory, automatic control mechanisms and miscellaneous instruments such as gas analyzers, pH recorders, electrical conductivity measurements, humidity and specific gravity recorders.

The employee must then pass a written examination on these subjects and he must also meet the following qualifications: Be familiar with the National Electrical Code for Fire Underwriters as applied to instrument work, be familiar with the Engineering Department electrical standards and piping standards, be able to use an Instrument Helper and to give him proper instructions for the purpose of training, be able to change charts, ink, clean, oil, adjust and make minor replacement of parts and do other minor maintenance on recorders, and be acquainted with other plant service departments and laboratory facilities.

After passing a written examination on the class training and meeting these qualifications, the employee is eligible to become a Journeyman Instrument Man. He is, however, placed in a "pool" and promoted to Journeyman Instrument Man when there is need for a man of these qualifications.

During the Instrument Helper and Senior Instrument Helper training periods the employee is trained to do work in all the jobs which he is expected to do. This includes the overhauling, repair, and lineup procedures on all types of instruments and controllers. This training is done with each individual man at scheduled intervals. Manufacturer's instruction sheets are followed by the student to learn the correct procedure for instrument maintenance. The Instrument Engineer instructs the employee in this work.

The formal education program ends with the Senior Instrument Helper III period. The following grading system is used: Notebooks 10%, periodic tests 25% and final examinations 65%.

Once each month the employee is graded on his personal accomplishments on a rating sheet. This rating sheet consists of nine numerically weighted boxes, three each for above average, average and below average accomplishments. The following items are rated: 1. A satisfactory days work. 2. Ability to perform jobs assigned. 3. Judgment. 4. Dependability. 5. Cooperation and attitude. 6. Initiative and job interest. 7. Cleanliness. 8. Safety. 9. Direction of others. 10. Planning for material, transportation, job layout and work of men. Items 9 and 10 are rated only when they apply.

The advance to Journeyman Instrument Man or Instrument Technician is a matter of time and experience. The qualifications for each classification are detailed in our shop agreements. These will not be discussed here but can be noted elsewhere.*

The employee is furnished all text books supplemented by manufacturer's literature and a bound set of 1000 questions used in conjunction to the text on industrial instruments. Each student is required to answer these questions in a notebook which is considered a part of the training course.

The preparation of the notebook is intended to accomplish the following purposes: 1. To assist the student in learning and retaining the knowledge contained in the text. 2. To serve as a valuable reference source for the student. 3. To give the student training in learning to express himself in describing the operation of the equipment with which he works. 4. To instill in the student a greater interest in the instrument trade. 5. To serve as a source of questions for examinations. 6. To serve as an excellent review for the student to prepare himself for the examinations.

The questions in the pamphlet are numbered, the first number denotes the question number and the second number refers to the page in the text where the answer to that particular question will be found. For example.

42.—30 Name several factors effecting the accuracy of a Bourdon tube pressure gauge?

43.—30 How are the adjustments of Bourdon tube linkages made?

275.—128 What is meant by "null" or "balance" type potentiometers?

276.—128 Name four advantages of a potentiometer type pyrometer?

This numbering system serves as a ready reference for the student and instructor.

The training courses were originally taught by the Instrument Supervisor; however, in recent years the Educational Department has been able to take over the review course for Instrument Helpers, and the blueprint and industrial instruments courses for Senior Instrument Helpers. The repair and lineup procedures are taught the Senior Instrument Helpers, individually, by our Instrument Engineer and Instrument Foremen.

The instructors are graduate Industrial Engineers, majoring in industrial education, who have received special training in the instrument shop and instrument manufacturer's training schools. They have their own office, files and stenographic assistance. Class rooms are provided with ample tables, chairs, and blackboards for the class use. Laboratory tables and apparatus are also provided in the Instrument Shop for use in experiments and special training.

Visual aids, such as 16 mm. sound projectors, film slide, standard and 2 x 2 projectors are available for the class use. Photographic facilities for making our own film slides and cutting records are available for making up special training films for use in the classes.

A reference library is maintained in the Instrument Department consisting of text books, hand books, catalogs, instruction books, wiring diagrams, etc., for the use by the instrument personnel. This supplements the main company library which contains a large volume of general technical literature.

While the instrument training course as described here has its shortcomings, it is presented as a program which has proved sound and workable. We are, however, open to practical suggestions for future improvement. It is hoped that it may assist, in a small way, to crystalize the proposed training course to be set-up by the Instrument Society of America committees for training instrument personnel in industry.

REFERENCES

Malcom B. Hall—The Development of Instrument Corricula, I. S. A. Conference, Philadelphia, 1948.

Rollin H. Briggs—Instrument Department Organization In a Large Chemical Plant. *Instrumentation*, Vol. 3, No. 2 First Quarter, 1948.

Fixed Gages--Their Design, Application, and Use

By F. STEELE BLACKALL, III†

THIS paper emphasizes the use and application of fixed gages, with consideration being given to the design of commonly-employed types, both standard and special, as follows: precision gage blocks; plain cylindrical, linear, and width gages, (plug gages, ring gages, snap gages, length gages); thread gages (plug gages, ring gages, snap gages); special gages (taper gages, spline gages, contour gages, flush pin gages, functional gages).

In discussing each of these gages, attention is focused on the respective qualities and relative merits of the materials available, such as hardened tool steel, alloy steel, chrome-plated steel, stellite, tungsten carbide, beron carbide, and synthetic sapphire. Certain design features created to permit greater speed of use and ease of handling, such as pilots, dirt grooves, progressive gage construction, and reversible characteristics also fall within the scope of the paper.

A thorough consideration of the various elements of fixed gage use should lead naturally to a clear understanding of what constitutes the optimum selection of gaging means in any particular case.

It is appropriate that a dissertation on the subject of fixed gages should begin with a consideration of precision gage blocks, for they are, for all practical purposes, the basic fixed gage, without which much of the tremendous industrial progress of the last half-century would have been impossible. These blocks, invented and developed by the late Carl Edward Johannson of Eskilstuna, Sweden, provided an accurate and reasonable method of obtaining fine measurements and made possible the widespread adoption of mass-produced inter-changeable parts for intricate machinery and equipment.

The gage block, as I am sure all of you know, is a square or rectangular block of alloy steel, with optically flat and parallel surfaces on either end with the dimension between them held within extremely close limits, the tolerance being as low as two microinches per inch of length on the finest blocks. They are produced in sizes ranging from 50/1000 of an inch to as much as 20 inches and may be combined by wringing the flat surfaces together to give whatever dimension is desired. It is possible, for example to obtain 120,000 different sizes in steps of 0.0001 inch with a complete set of 81 blocks.

In view of the obvious fact that accuracy requirements differ for different applications, blocks are produced in three classes: "AA", accurate within 2 microinches for use in laboratory and reference work; "A", accurate within 4 microinches, for use in inspection; and "B" blocks, accurate within 8 microinches, for the use of gage and tool makers and on-the-job inspection.

Gage blocks are used primarily for the inspection and setting of other fixed gages and of comparators and the like. "Work" blocks are, of course, used by the employees in the tool room both for checking gages, micrometers, and calipers, and for actually measuring the work.

Although Tungsten Carbide blocks can be obtained in order to prolong life by limiting wear, complete sets involve substantial expense. In view of this fact many manufacturers sell special Tungsten Carbide blocks in commonly used sizes, such as 50/1000 and 100/1000 of an inch.

Before proceeding further with the subject of fixed gaging, it is important to settle the exact definition of a few commonly-used terms.

Although "go" and "not go" gages can be verbally differentiated in many ways, perhaps the clearest way to make the difference clear is to point out that "go" gages check the maximum metal condition and "not go" gages check the minimum metal condition; thus a "not go" plug gage is larger than a "go" plug and a "go" ring gage has a larger hole than a "not go" ring gage. By their very nature, the "go" gage should be designed to check as many dimensions as possible and the "not go" gage to check but one. Another important distinction to be borne in mind is the different classifications of gages. There are Master gages, used for the inspection and setting of other gages, Inspection gages for the final inspection of the work, and Work gages for use in checking parts as they come off the machine. The obvious differences in accuracy requirements for these applications are reflected in different tolerance specifications and selling prices for each category. Thus a master gage must be manufactured within closer limits and sold at a substantially higher price than a work gage.

Perhaps the most common type of gage in use is the plain cylindrical plug gage for the measurement of internal dimensions both at the machine and in final inspection.

Although double-end construction is more common in smaller sized gages, single end construction is preferable for use in checking of larger diameters or bores of greater depth, in order to accomplish greater ease of handling by minimizing weight. In addition, of course, there are many applications involving interchangeability of simple parts where dimensional limits are broad enough to permit the use of "go" gages alone.

In order to prolong gage life, reversible construction has recently received considerable attention. This merely means that when one end has become worn, the gaging plug may be reversed, thereby doubling the useful life of the gage.

As inspection with fixed gages is one of the few remaining complete hand operations in an era of great mechanization, it is by its very nature a relatively high cost procedure. It is important therefore to examine some of the design features which have been developed to reduce inspection time. The widespread adoption of progressive construction, or the combination of the "go" and the "not go" elements on the same plug, is an example of this. It is, of course, not applicable to holes of large diameter or of great depth due to the weight consideration and has the disadvantage of being useful only where both the specific "go" and "not go" limits are required. In addition, the gage must be scrapped when either element has become worn.

The employment of plug gages with pilots is another example. It combines the advantage of providing a means of rapid and convenient entry of the plug into the hole with the avoidance of any marring or scratching of the finished surface. There are several different pilot designs: The Pratt and Whitney pilot, which utilizes a narrow land about 1/32 to 1/16 of an inch in length in front of the body of the gage; the Taft-Peirce pilot, which employs a spherical segment ground in the entering end of the gage, and the Emmerton pilot, which makes use of a ring of hardened steel balls inclosed in an annular retainer encircling the end of the gage.

Each or any of these pilot designs are useful in improving efficiency in inspection if holes are of close tolerance or if the product is bulky and difficult to handle. Furthermore, they have been found valuable in preventing the shaving action often occurring when the inspected part is manufactured from soft metal. They have proven extremely effective in the hands of unskilled help for routine inspection work.

For inspection of shafts and external diameters, plain ring gages and snap gages of either the solid or the adjustable type will be found quite satisfactory. Although the "go" and "not go" ring gages must be used singly, any type of progressive construction being impractical, due to the difficulties encountered in the lapping operation, the ring gage has one important advantage. It checks for size, taper, and out-of-roundness at one trial, whereas other gages do not give complete inspection unless they are tried at several places along the shaft.

Snap gages may be obtained in either solid or adjustable construction. The solid design may consist of two gaging members opposite one another on separate pairs of jaws, but the overwhelming majority are of the progressive construction, that is with both the "go" and "not go" dimensions on the same pair of jaws.

Although many solid snap gages are still in use, the adjustable type has become far more popular in recent

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*Presented at the Fourth Annual Conference of the Instrument Society of America, Sept. 12-16, 1949, St. Louis, Mo.

Note:—Statements and opinions advanced in papers are to be understood as individual expressions of the authors and not those of the Society.

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years. These gages may be of pin, button, or anvil design, each of which may employ four gaging members or two gaging members and a solid anvil. The button and anvil type, while somewhat more expensive, permit wider distribution of wear and easier application to the work than the pin type. It is apparent that with readjustment or replacement of the gaging surfaces a simple procedure the life of a snap gage is far greater than that of other fixed gages. One inherent disadvantage of the snap gage is that it checks a part at only one point at a time; thus if it is necessary to check at several places, it may be advisable to use some other type of gage. For example, if out-of-roundness is suspected, it may be advantageous to use a "go" ring gage in combination with a "not go" snap gage.

Generally speaking, it may be said that a length gage starts where a snap gage ends. They too may be of solid or adjustable construction, in either the double-sided or progressive model.

For the inspection of threaded products, the thread plug gage is used almost exclusively, while for external threads, the thread ring and two styles of thread snap gages are available. The "go" plug gage is of full form thread and is designed to check the sum of errors in lead, thread angle, major diameter and pitch diameter. The "not go" plug gage is relatively short and has a truncated major diameter and a relief at the thread root, so as to accept only work which is not oversize on the pitch diameter. The truncation is occasionally used on a portion of the "go" plug as well, so that it will be possible to determine whether it is the pitch diameter or the major diameter that is oversize.

Here, as with plain plugs, the single end, double end, and reversible constructions are available with their same advantages and limitations.

Thread plug gages are normally equipped with some means of eliminating loose chips from the hole to be measured, both to increase speed of inspection and to reduce wear. This may be accomplished by the inclusion of a dirt groove on the surface of the gaging member parallel to its central axis, or by the use of a square end so that chips are pushed out ahead of the gage.

Another recent and useful development is the power thread gaging handle, which eliminates manual rotation of the gage. This electrically operated device permits rapid insertion and extraction of the gaging member, with reversal of revolution automatically accomplished by a slight change in the applied pressure. It is of light construction and may be moved about readily.

Thread ring gages differ from plain ring gages in that the rings are split to permit adjustment for the purposes of the lapping operations in their manufacture. These splits fulfill the need of dirt grooves and provide some room for adjustment for wear. As with the thread plug gage, the "not go" gage is truncated, this time on the minor diameter, and contains a relief on the major to assure checking of the pitch diameter alone, while the "go" gage is designed to check a combination of all the possible errors, but does not permit the inspector to distinguish between them.

In view of the fact that thread snap gages are easier and quicker to use, and are able to distinguish between different types of errors, they are rapidly displacing thread ring gages in many applications. Furthermore the adjustable feature and the ease with which gaging members may be replaced give the snap gage the distinct advantage of longer life and lower net cost, in spite of its higher initial cost.

Both the anvil and roller types require considerably more care and time for the original adjustment than do plain snap gages, due to the fact that the "go" and "not go" members must be in correct alignment and the upper and lower members must be in correct relation to each other. This means that it would be impractical to utilize the thread snap gage unless the number of parts to be inspected were of considerable size. The roller type has slightly better wear resistant qualities, for wear is distributed over the entire circumference and not concentrated at a single spot.

In discussing special gages of the fixed type, it is necessary to differentiate between those that are normally catalogued by the gage makers, although special in that they are not made to the dimensions of any standard, and the gages that are designed for a distinct inspection operation though the dimensions may correspond with those of some adopted standard. The dollar volume of the latter category represents just about one half of the gage production of the country, so it is a field that is worth serious consideration and study in any gage program.

For the inspection of tapers, the plug and ring gage designs are generally employed, although many are of the blade type which enable the inspector to obtain a more effective check of the degree and uniformity of the taper. The plug and ring gages are usually manufactured to the product dimensions for the angle of the taper and the diameter. The tolerance on the diameter is customarily converted to a length tolerance by the formula

$$T_L = (T_D/2) \times \cot \alpha/2$$

where T_D is the diametrical tolerance and α is the included angle of the taper.

A step is then ground, usually in the large end of the plug and the small end of the ring, to a depth equal to the length tolerance. This permits ready inspection of the product for all specified dimensions with one application of the gage. Where reasonable tolerances are permitted on the taper, the "feel" of the gage when applied to the work will indicate any appreciable variation from the standard, and where a very close fit must be maintained, a light coat of Prussian Blue will indicate the uniformity of or variation from the exact taper. The size of the diameter will be determined by the relationship between the end of the taper and the steps on the gage. Where a blade type gage is used, the uniformity of the taper can readily be determined by reviewing the conformity of the knife edges or flat blade with the surface of the work pie[illegible] The diametrical size can be guage[illegible] from [illegible] step or graduated line on the [illegible]lade.

Also falling within the spe[illegible]l gage category is the spline gage. F[illegible] many years the more commonly used splined fittings were the parallel sp[illegible]es of six, eight, and ten slots, with [illegible]he di-ameters and lengths selected [illegible]o con-form with the requirements of [illegible]he de-sign. Of recent years the [illegible]rrated fitting and the involute splin[illegible]s have become very popular because [illegible]f the increased bearing surface and [illegible]he ease and economy effected in the manufacturing process. The "go" gages used for the inspection of product members which carry splined shafts and holes are manufactured to the maximum metal dimensions of the work and conform to the specific spline specifications in all respects for spacing, contour, size, etc. Frequently the "go" gage alone is considered to be satisfactory for the inspection operation, as the fit or looseness of the gage readily indicates the probable quality of the product, but where a particularly high degree of quality and uniformity must be maintained, a "not go" gage or set of gages is desirable. For the involute spline, the "not go" gage usually consists of a short section having approximately three teeth on each side which, if applied to the work at several different points, will indicate any variations in spacing, contour, or roundness falling outside of the tolerances allowed. The "not go" gages for the parallel spline usually consist of a set of gages which will check the width of the spline or space and both of the diameters.

Another type of fixed gage produced according to a wide variety of designs is the contour gage. It is widely used to determine the accuracy of the form of a concave or convex radial contour, an angular or conical shape, or any other geometrical or irregular profile which must be machined or finished to a specific outline. These gages are usually made of steel with a thin section, or perhaps a beveled edge, having the contour of the work piece accurately reproduced on the edge of the gage. These gages are not limit gages in the usual sense but are made to the mean or maximum metal dimensions of the work and, when brought into contact with the work profile, permit the inspector to classify the work as acceptable or not acceptable by comparison with the gage. It is possible to determine both the correctness of the contour of a given section of the work and the relationship of two or more sections. This type of gage, used in almost all cases for visual comparison, should be viewed with a lighted screen or window as a background in order to relieve the inspector from eye strain and consequent inaccuracy.

Many gages of similar design and construction are used for the inspection of lengths, diameters, spacing of grooves, and slots, and also for angle and shoulder work where standard types of gages are not suitable. These, of course, are essentially simple contour gages with ground steps or graduated lines provided to permit accurate comparison with the dimensions of the work piece.

Another type of special fixed gage is the flush pin gage. It is customarily

used for the inspection of a depth dimension or to determine the relationship of two or more parallel plane surfaces. The body of the gage is usually of some common geometric pattern, such as a bar of rectangular section, a circular disk, a truncated cone, a threaded cylinder, or some other shape which will conform to the surface from which the measurement is to be made. A pin is fitted in a hole in the body at such a location as to permit the end of the pin to contact the surface related to that on which the gage body is resting. The body of this gage is usually provided with a step of a depth which corresponds to the tolerance applicable to the dimension to be inspected. This step is ground at a point where the parting line will approximately intersect the center line or axis of the pin. Thus, when the gage is applied to the work, if the pin and body are in proper contact with their respective surfaces, the measuring end of the pin should be between the high and low steps of the body. If the pin end extends above the high step or below the low step, the dimension is not within the tolerances. In some cases where the tolerances are close, it is desirable to provide the gage with an indicator mounted on the body with its stem contacting the measuring end of the flush pin. This construction permits the inspector to measure the dimension easily and determine the exact amount of the error if outside of the tolerances.

A final classification of fixed gages of special design is the functional gage, frequently of rather involved and complex design. There are many types and they are widely used where the relationship of certain surface holes and contours must be maintained through careful inspection of the product both during the machining operation and at final inspection. A very good example of this type is the concentricity gage, which in its elementary form may consist of two cylinders of different diameter ground on the same gage body and with a common axis. This gage is finished to the minimum dimensions of the work or slightly less by the eccentricity tolerance and indicates readily the relationship between the two bores if they are within the allowed tolerance for size and concentricity. A more complex gage of this type consists of a threaded member and one or more plain cylindrical members ground on the same gage with the axis of the helix corresponding with the axis of the cylinders. This gage, of course, is used to determine the relationship of the various threaded and plain diameters involved and accepts or rejects the product by its entry or failure to enter the work piece. Another type of functional gage is of the template type with plugs or studs arranged to enter the corresponding holes in the work which have previously been drilled and reamed or otherwise finish machined. When applied to the work piece at inspection, the plugs should all enter their proper holes and any other surfaces should correspond with the template contour or with any other gaging means used to check the work surfaces. Many other gages have been designed to accomplish the same end result and many ingenious arrangements of gaging members have been devised.

A great majority of the gages presently in use are manufactured from hardened tool steel. This material is entirely suitable for most applications, provided, of course, the gages are given proper care. This means that both the gages and the parts to be inspected be clean and that no more pressure than necessary be applied to them, such as by the frequent use of dogs or clamps to assist in forcing plugs into holes. If normal precautions are taken, gage wear will average about 1/10,000 of an inch per 1,000 applications.

However, when the use of any of the product tolerance for a wear allowance is impossible because of the extreme accuracy required in the finished dimension, or when a large quantity of parts must be inspected, attention should be given to selecting a material which will reduce wear and lengthen gage life.

The application of hard chrome plate to the gage before finish grinding and lapping has been one of the most common methods of accomplishing this. The procedure has been found to produce gages lasting about four times as long as ordinarily hardened steel gages and at a reasonable cost. Furthermore, chromium plating virtually eliminates the possibility of corrosion. In addition to its use in the manufacture of new gages, chromium plating has been found very useful in restoring worn gages to size. Such a reconditioned gage is every bit as good as a new one and thus before worn gages are discarded, the possibility of plating should be examined.

If the requirements of the job are such as to demand more durability than this, it may be economical to utilize gages manufactured from harder materials, such as tungsten carbide, beron carbide, stellite, norbide, or synthetic sapphire. With these materials, it is frequently possible to increase ultimate gage life from 50 to 100 times that of a steel gage and at an initial cost of perhaps four times as much. All of these materials are extremely brittle and therefore gages manufactured from them require somewhat more care in handling than hardened steel gages.

I hope that the information which I have presented will permit greater understanding and appreciation of the types and applications of fixed gages. Only with a clear picture of the relative advantages and disadvantages of fixed gages coupled with a familiarity with automatic and semi-automatic gaging methods is it possible to achieve optimum selection of gaging means for any particular application.

ISA EMPLOYMENT SERVICE

Forward your letter to INSTRUMENT SOCIETY OF AMERICA, 921 Ridge Ave., Pittsburgh 12, Pa.

• • •

DESIGN ENGINEER. Wanted by New England concern, experienced Design Engineer versed in theoretical and practical horology, preferably graduate of watch or clockmaker's institute for work on various timing devices. Write stating age and qualifications. Location: Connecticut. Box 258.

• • •

INSTRUMENT MECHANIC. High school graduate preferably with trade school and instrument maintenance and installation experience. Must have adequate knowledge of Foxboro, Mason-Neilan, Taylor, Leeds and Northrup, pressure and temperature recorders, controllers, regulators, gages and must be able to adjust and calibrate all such instruments. Salary will be commensurate with background. Location: New Jersey. Box 259.

• • •

DESIGN ENGINEER. One who has had considerable background in the design and manufacture of bearings, particularly bearings which are made entirely of sapphire or which have sapphire components. Location: Illinois. Box 260.

• • •

ASSISTANT GENERAL MANAGER. Graduate E. E. or M. E. preferably with additional studies in Business Administration. Experience in metal industry, technical, precision, electrical or mechanical machinery or instruments to include organization and administration as related to management, investigation analysis and coordination of engineering, manufacturing and sales, budgets and cost reduction. Production experience in a line position as background for administrative duties. Age 38 to 45. Location: Connecticut. Box 261.

• • •

ASSISTANT TO SALES MANAGER. Graduate E. E. or M. E. with equivalent electrical knowledge from subsequent training and experience. Experience in the metal industry in the sale and service of electrical and mechanical machinery or instruments to include: 1—Sales management either as assistant sales manager or district manager; 2—Sales engineering in industrial electrical and mechanical equipment; 3—Field Service preferably as service engineer and customer relations in the field. Will travel to contact district offices, customers, sales meetings. Age 35 to 40. Location: Connecticut. Box 262.

• • •

SALES OFFICE SUPERVISOR. Graduate E. E. or M. E. with equivalent electrical knowledge. Experience in the metal industry in the sale and service of electrical and mechanical machinery or instruments to include: 1—Sales office procedures, technical and sales liaison, and correspondence; 2—Sales engineering; 3—Training preferably the usual shop test course and subsequent office training. Travel limited. Age 30 to 40. Location: Connecticut. Box 263.

• • •

COMMERCIAL ENGINEER. (2 positions open) Graduate E. E. or M. E. Experience in sales and service of electrical and mechanical machinery and procedures as related to office, shop and field. Travel 25%. Age 30 to 35. Location: Connecticut. Box 264.

• • •

SALES ENGINEER. To sell recording and controlling instruments as made by nationally known company. Training and experience in use and application of these instruments required. Position permanent. Salary and bonus. Location—Detroit. Box 265.

• • •

SALES MANAGER. By small old established industrial thermometer recorder and controller manufacturer. Must be able to personally contact home office territory, be good correspondent and competent to handle and increase present Agency representative program. Chicago area. Box 266.

ISA Section Transfer Procedure

The Membership and Section Sub-Committee on ISA membership has recommended the initiation of a procedure designed to facilitate the transfer of member affiliation from one ISA Section to another.

Members who wish to transfer Section affiliation should fill out in duplicate the new "Application for Membership Transfer" form and mail both copies to the Secretary of the Section with which they wish to commence affiliation.

Upon approval of this transfer, the Secretary of the new Section will mail one copy of the approved blank to the

National Office to effect the change in records and will mail the other copy to the Secretary of the member's original Section to serve as an official notice of such transfer.

Affiliaition with the original Section continues until the member's transfer is effected.

Section Secretaries may obtain copies of the form from the National Office.

Section Secretaries, Meeting Data and Programs

ALBUQUERQUE
L. J. Paddison, 911 Parkland Circle, Albuquerque, N. M.

AKRON
Fred Appel, 932 Columbia Ct., Barberton, Ohio.
Fourth Tuesday, Meeting at 8:00 P. M.

ARUBA
A. S. MacNutt, c/o Lago Oil & Transport Co., Ltd., Aruba, N.W.I.
First Tuesday, Meeting at 7:15 P. M.

ATLANTA
H. Kockritz, Fischer & Porter Co., 84 Peachtree St., Atlanta, Ga.
Fourth Monday, Meeting at 7:45 P. M.

BALTIMORE
George B. Greer, 631 E. 36th St., Baltimore 18, Md.
Second Friday.

BATON ROUGE
James H. Simpson, 3647 Gladiola, Baton Rouge, La.

BOSTON
C. J. Nazzaro, 456 Central Avenue, Milton 87, Mass.
Last Wednesday, Dinner at 6:30 P. M.., Meeting at 7:00 P.M.

CALIFORNIA
D. D. Taylor, 1958 Mendocino Lane, Altedena, Calif.
First Tuesday, Dinner at 6:30 P. M. Meeting at 8:00 P. M.

CENTRAL ILLINOIS
H. F. Lange, 2101 W. Glen Avenue, Peoria 5, Ill.
First Wednesday, Dinner at 6:30 P.M., Meeting at 7:30 P.M.

CENTRAL INDIANA
H. F. Coffey, 110 G Nelson Ave., Tyndall Towne, Indianapolis, Ind.
First Tuesday, Meeting at 7:30 P. M.

CHARLESTON
Albert H. Hix, 1007 Fifth Ave., St. Albans, W. Va.
First Monday, Dinner at 6:30 P.M., Meeting at 8:00 P.M.
January 9, "The Maintenance of pH Instruments," E. A. Bryant, E. I. Dupont de Nemours.
February 6, "What Makes an Instrument a Good Instrument?", R. E. Clarridge, Taylor Instrument Cos.

CHICAGO
Floyd E. Ertsman, Rm. 1420 Fisher Bldg., 343 S. Dearborn St., Chicago, Ill.
Third Tuesday, Dinner at 6:45 P. M., Meeting at 8:00 P. M.
December 20 (Tuesday). Western Society of Engineers (84 E. Randolph St.,). "Flow Plan Symbols," Dave Hostedler, Foster Wheeler Co.
January 17, Western Society of Engineers (84 E. Randolph St.). "Automatic Control and the High Speed Analog," G. A. Philbrick, G. A. Philbrick Researches, Inc.

CHINA LAKE
A. G. DeBell, U. S. Naval Ordnance Test Sta., China Lake, Calif.

CINCINNATI
Edward H. Muhleisen, 320 Durrell Ave., Cincinnati 15, Ohio
First Monday, Meeting at 8:00 P. M.

CLEVELAND
R. M. Woodside, 332 Oakmoor Rd., Bay Village, Ohio
Fourth Wednesday, Dinner at 6:30 P.M., Meeting at 8:00 P.M.

COLUMBUS
Orval Linebrink. c/o Battelle Memorial Institute, 505 King Ave., Columbus, Ohio
Third Thursday

CUMBERLAND
Clyde Babst, 225 Cecilia St., Cumberland, Md.
Tuesday after Fourth Monday, Dinner at 6:30 P.M., Meeting at 8:00 P.M.

DETROIT
Seymour Sterling, 13331 Linwood, Detroit, Mich.
Second Wednesday, Meeting at 8:00 P. M.

EASTERN NEW YORK
J. M. Wilsey, c/o General Engineering & Consulting Lab., General Electric Company, Schenectady, N. Y.
First Tuesday, Dinner at 6:30 P.M., Meeting at 8:00 P.M.

GULF COAST
W. N. Sloan, 2558 Tyrrell Parkway, Port Arthur, Texas.
Third Tuesday. Meetiing at 7:30 P. M.

HOUSTON
E. E. Kleir, c/o The Foxboro Co., 2518 S. Blvd., Houston 6, Texas
Last Monday, Meeting at 8:00 P. M.
January 30, "Improvised Instrumentation," R. L. Nichols, Magnolia Petroleum Co.
February 27, "The Manufacture of Starch for Food and Industry," T. H. Pierson, Corn Products Refining Co.
March 27, Banquet and Installation of New Officers.

KANSAS CITY
Lewell F. Spies, c/o J. F. Pritchard & Co., 908 Grand Ave., Kansas City. Mo.
First Tuesday, Meeting at 7:30 P. M.
January 10, "Combustion and Boiler Control," M. J. Boho, Hagan Corp.
February 7, "pH Control and Its Applications," Dr. A. O. Beckman.
March 7, "Refinery or Chemical Process Control," Hart Fisher, Monsanto Chemical Co.

LOUISVILLE
H. C. Scherffius, 980 Palarka Rd., Louisville, Ky.
Fourth Tuesday, Meeting at 8:00 P.M.

MONTREAL
L. J. Mizuhara, Monsanto (Canada) Ltd., 425 St. Patrick St., Ville LaSalle, Quebec, Canada
Last Monday, Meeting at 8:00 P.M.

NEW JERSEY
W. D. Archibald, 605 Westminster Ave., Elizabeth 3, N. J.
First Tuesday, Dinner at 6:00 P. M. Meeting at 8:00 P. M.
January 3, "Photoelectric Cells; Their Practical and Unusual Applications; Their History and Their Future," Anthony H. Lamb, Weston Electrical Instrument Corp.

NEW ORLEANS
W. H. Haney, 2927 Music Avenue, New Orleans, La.
No Regular Date, Meeting at 8:00 P.M.

NEW YORK
Norman J. Cherry, P. O. Box 608, Merrick, L. I., N. Y.
Last Monday, Meeting at 7:30 P. M.
Special Program Series—January 16—B.T.U. Measurement.
January 27-28, January Conference at Statler Hotel. "Temperature Measurements", Theory, Practical Instrument Application and Maintenance Problems. Banquet on Friday Evening.

NIAGARA FRONTIER
Mrs. James L. Martin, 697 Potomac Ave., Buffalo 9, N. Y.
Fourth Monday, Dinner at 6:15 P.M., Meeting at 8:00 P.M.

NORTH TEXAS
R. E. Byers, 6000 Lemmon Ave., Dallas 9, Texas

NORTHERN CALIFORNIA
M. A. Dimmick, 5607 Alta Punta, El Cerrito, Calif.

NORTHERN INDIANA
J. Baum Beckman, 547 N. Waller Ave., Chicago 44, Ill.
Third Wednesday, Dinner at 6:30 P.M., Meeting at 7:30 P. M.

OAK RIDGE
John H. Clark, 138 Clayton Hall, [illegible]ridge, Tenn.
First Wednesday, Dinner at 6:30 P. [illegible] Meeting at 7:30 P. M.

ONTARIO
John W. Huether, 311 Southerland [illegible] Leaside, Ontario, Canada
Third Thursday, Dinner at 6:45 P. M. [illegible]eeting at 8:15 P. M.

PHILADELPHIA
C. W. Wood, 6908 Market St., Upper Darby, Pa.
Third Wednesday, Meeting at 8:00 P. M.
December 21, "New and Interesting Developments in Television."

PITTSBURGH
Miss Louise Suckfield, P.O. Box 2038 Pittsburgh 30, Pa.
Fourth Monday, Dinner at 6:30 P.M., Meeting at 8:00 P.M.
December 19, "Magnetic Amplifiers," F. N. McClure, Westinghouse Electric Corp.
January 23, "Stump the Experts." A Maintenance Clinic moderated by Charles B. Cochran, Peter Loftus Corp.
Pittsburgh Inspection & Gaging Sub-section. Meeting at 8:00 P. M.
December 20, "Inspection of 5 inch/38 Caliber Projectiles," A. S. Marthens and David Siegel, U. S. Navy Inspection Service.
January 10, "Inspection in the Machine Shops Handling Large Heavy Work of High Degree of Accuracy," G. W. Linkhauer, United Engineering & Foundry Co.

PRESQUE ISLE
Edwin P. Schuwerk, 445½ Halley St., L. P., Erie, Pa.
Fourth Tuesday, Meeting at 8:00 P.M.
January 24, Open forum on instrumentation problems.
February 27, "Control Valves," T. L. Smith, Belfield Valve Div., Minneapolis-Honeywell Regulator Co.

RICHLAND
M. T. Slind, M-6, Rm. 107, Richland, Washington
Second Wednesday, Meeting at 7:30 P.M.

ROCHESTER
R. C. Schwarz, Jr., 1201 Granite Bldg., Rochester 4, N. Y.
Fourth Tuesday, Meeting at 8:00 P.M.

ST. LOUIS
W. G. Lee, 4710 Delor St., St. Louis 16, Mo.
First Wednesday, Meeting at 8:00 P.M.
January 11, "Control of Combination Fired Furnaces," M. J. Boho, Hagan Corp.

SARNIA
Fred T. Yorke, P. O. Box 213, Point Edward, Ontario, Canada
Second Friday.

SOUTH BEND
Sam M. Rouse, 436 Moccasin Ave., Buchanan, Mich.
First Thursday. Meeting at 8:00 P. M.

SOUTH MICHIGAN
Larry DeHann, 1117 Cobb Ave., Kalamazoo, Mich.
Second Wednesday, Dinner at 6:30 P.M. Meeting at 8:00 P.M.

SOUTH TEXAS
H. C. Givens, La Gloria Corp., P.O. 637, Farfurrias, Texas
First Thursday. Meeting at 7:30 P. M.

TENNESSEE
N. M. Taylor, 16 Edgewood, Kingsport, Tenn.
No definite night, Dinner at 6:45 P. M., Meeting at 8:00 P.M.

TULSA
C. R. Horton, 8211 E. 7th, Tulsa, Oklahoma
First Monday, Meeting at 7:30 P.M.
January 9, "Control of Combination Fired Furnaces," M. J. Boho, Hagan Corp.

TWIN CITIES
Alden Hine, c/o Giesika & Pinkney, 552 Plymouth Bldg., 6th & Hennepin Ave., Minneapolis 2, Minn.
Fourth Tuesday, Dinner at 6:30 P.M.

WASHINGTON
G. M. Rolls, c/o American Instrument Co., 8010-20 Georgia Ave., Silver Springs, Md.
Third Monday, Meeting at 8:00 P. M.

WAYNE COUNTY
Robert Karr, 2455 Biddle Ave., Wyandotte, Michigan
Third Monday, Dinner at 6:30 P.M., Meeting at 8:30 P. M.

JOURNAL of the
Southern California Meter Association

President: Robert F. Fields
Vice-President: James E. Adams
Secretary-Treasurer: George H. Foster, 2916 Eucalyptus Ave., Long Beach 6, Calif.
Auditor: John T. H. Morris
Past-President: J. C. Groenewegen

Measurement *and* Control *at* Trona

By CLIFFORD H. CEST, Controls Engineer, American Potash & Chemical Corp., Trona, Calif.

IN general, the automatic control and metering of chemical processes is not as well developed as refinery and gas applications. This lag is due in large part to the greater variety of chemical over refinery processes. In my opinion, our problems have the same bases as those in the refinery field, the difference being one of quantity rather than quality of the various troubles to which an instrument man may fall heir. We can use standard metering and control instruments, but we often use them in new ways. In short, there are few standard "packaged" control systems available for use in processes such as the manufacturing operations at Trona.

The town of Trona is located about twenty miles east of the Navy's new Ordnance Test Station at Inyokern, and about sixty miles west of Death Valley. In this Mojave Desert section the average annual rainfall for the period 1937-1947 inclusive was 4.6 inches. And yet, on the shores of a dry lake, Searles Lake, an investment of close to thirty million dollars has been made for the recovery of chemical salts from lake brines. In order to staff the manufacturing plant, a village of 550 families together with single quarters for 1000 persons, a 20-bed hospital, a shopping center doing a $2,000,000 business annually, and village services such as garbage collection, power, etc., have been built, and surrounding private developments of late years have added a population of 1000 to the community. Thus, about 4000 persons depend in some way on this one industry.

Searles Lake, named after the original developer of the borax deposits, is about eleven square miles in area, and has commercially developed salt beds to a depth of 90-100 feet with other deposits at greater depths now being developed. It is a porous deposit of various complex inorganic salts containing borax, potash, soda ash (or Na_2CO_3), salt cake (or Na_2SO_4), bromides, and lithium salts—all of which are now recovered—and various other minor constituents not now being recovered on a commercial scale.

The salt deposit is not uniform in composition but, as shown in the typical cross-section, Fig. 2, varies in the amounts of various salts present. It is normally saturated with brine from

*Presented before the Southern California Meter Association.

January Meeting: Thursday the 19th, Rio Hondo Country Club, Downey, Calif. Dinner, 6:30; meeting, 8 sharp. *Feature*: an up-to-the-minute paper on Brodie Meters—construction, operation and maintenance—by Paul Renfro. Non-members cordially invited.

—THERON S. CODY,
Publicity Chairman

Fig. 1. Plant and part of village.

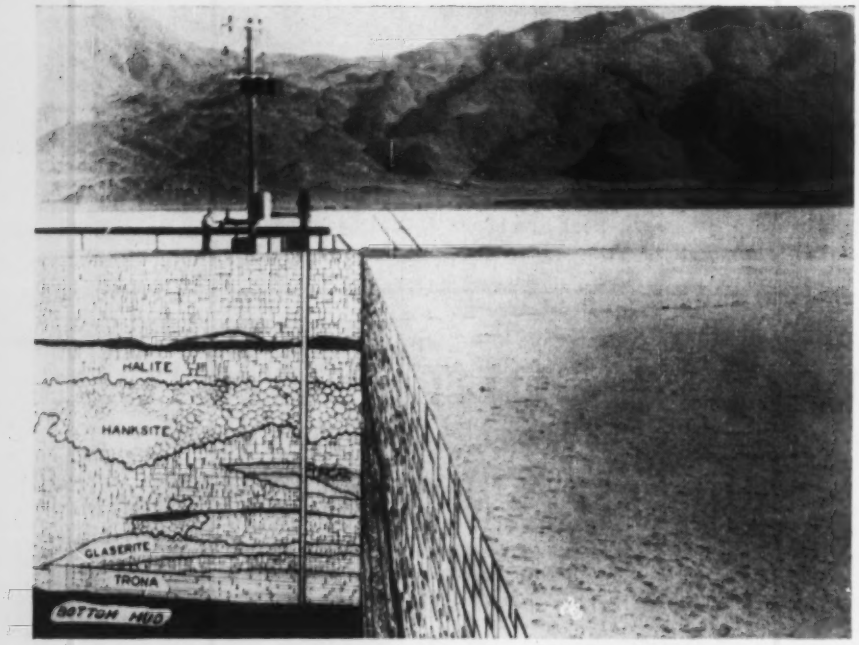


Fig. 2. Typical section of lake.

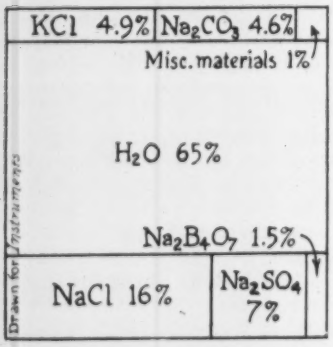


Fig. 3.

a few inches below its surface on down, and the brines from different sections reflect the surrounding salts in their composition. Therefore, drilling of wells and pumping of brines—which serve as Trona's raw material—are adjusted to maintain the most desirable composition of feed to the plant. Brine is pumped from the lake at a rate of about three million gallons per day. From this brine the various products are recovered at the rate of 2100-2200 tons per day. A typical brine as pumped from the lake analyzes as shown graphically in Fig. 3.

Incoming brine, containing our products in solution, enters the Main Plant Cycle at the evaporators where, together with the tail liquors—about 1½ million gallons per day—it is concentrated by triple-effect evaporation to a total flow of 1½ million gallons per day. If these figures do not adequately convey to the mind an idea of the magnitude of the operations at Trona, the photograph, Fig. 5, will convey it to the eye: this picture shows the third effect pan of No. 3 evaporator unit.

Salt is deposited when the brine is evaporated; and the tubular heaters are located outside the pans so that they may be isolated and washed free of salt without shutting the evaporators down. Heating in the first effect is by steam from the Power House, exhausted from the turbines. These turbines produce electric power for the plant and village at a rate of 30,000 kilowatts—sufficient for a city of some 70,000 people. The condensate from the heaters is returned to the boilers. Vapors from the first effect are used to heat the second effect at a lower pressure, and from the second effect to heat the third effect at a pressure of about 1.5 in. Hg. abs. This vacuum is maintained by means of a jet of cool water in the barometric condensers, and this water is returned and cooled in one of the world's largest installations of cooling towers.

Fig. 4 is a diagram of what we call our Main Plant Cycle. Starting with the concentration step, NaCl and other sodium salts drop out during evaporation and are recovered by means of settling devices and filters and sent to the Soda Products Plant for separation of soda ash and salt cake. Water is also recovered, and a large part of plant water is condensate from evaporation. Trona must conserve and recover all possible water to exist. The concentrated liquor saturated with NaCl salts at 230 degrees F. goes to the Potash Plant to be cooled, when a crop of potash drops out. The resulting liquor is now supersaturated with respect to borax, and must be transferred to the Borax Plant for further cooling and recovery of borax. Fortunately borax crystallizes relatively slowly in the absence of seeding, so this can be done. After recovery of borax the tail liquors, saturated with sodium salts, potash, and borax are returned to the evaporators together with the incoming lake brine.

The original brine as pumped from the lake is saturated with NaCl, and this comes down in the evaporators, together with sodium carbonat and sulphate, mostly as a series of ouble salts, called burkeite after . E. Burke, one-time manager at Tro a and discoverer of the mineral. Thes salts are separated in the salt trap and clarifiers, NaCl separated by hy aulic classifiers, and the burkeite sen as a sludge to the Soda Products lant.

Fig. 6 will give some idea the complexity of the Soda Products proc- ess, and I may mention again that this plant produces more than 600 tons of finished Na salts daily. Splitting of the double salt, burkeite, is done by adjustment of NaCl content, temperature, and concentration, to take advantage of different solubilities of the salts under different conditions. We could discuss at length almost any step shown in Fig. 6, since the carbonate and sulphate appear as several hydrated salts during the process, but this outline may serve as a background for later discussion of instrumentation. Practically every liquid flow shown here—as well as in the other figures—is saturated and/or supersaturated with one or more inorganic salts, most of the flows are carrying solid salts, and composition, density, and temperature are always critical.

(EDITOR'S NOTE. Four process drawings all similar to Fig. 6 in style, lettering sizes, etc., are omitted because they would take two full pages to be legible.—MFB)

This has been a very sketchy outline of the main Trona process. The process is continuous, of course, and some idea of the amount of integration which has occurred during the plant development can be gained from the fact that a shutdown of any unit of the Main Plant Cycle for more than a few hours requires coordination with all other plant departments. From the control angle, most liquid flows are saturated or supersaturated with one or more inorganic salts, and most of the flows are carrying solid salts. Com-

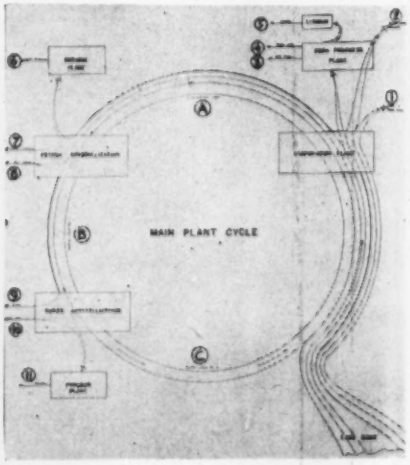


Fig. 4. Showing major solution and product flows.

1. Water to power house
2. Sodium chloride removal
3. Salt cake
4. Soda ash
5. Licons
6. Liquid bromine
7. Chemhi potash
8. Aghi potash
9. Borax
10. Boric acid
11. Pyrobar
A. Concentrated liquor
B. Mother liquor No. 1
C. Mother liquor No. 2

position, temperature, and density are always critical.

Practically every step in the Trona plant, excepting the Carbonation Plant, is controlled manually at the present time, and this control depends upon constant laboratory analysis at many points in order to operate. There are few men of the more than five hundred working in the Production Department who are not required to take samples, compare colors, perform simple titrations, or determine densities, as a regular part of their jobs. Automatic control has been almost limited to temperature and level applications until the last year or two. Fluid metering, except for lake brines coming to the plant, and water flows, is present but generally in disrepute. Methods for continuous analysis of solutions, extremely important to control, are not yet developed.

These remarks do not apply to the Power House. Here, more or less conventional automatic combustion controls are used to a large extent.

These general remarks show the variety of operations in progress at Trona. Now I hope to get to cases with some of our more difficult problems—how we hope to solve them, and what we have so far accomplished—and to present a few interesting applications we have made.

For control purposes our most widely used variables are temperature, flow-rate, liquid level, and density. Temperature determinations present little in the way of unusual troubles, although high temperature measurement in the presence of borax and soda ash (both excellent fluxes) mean rapid deterioration of protective wells and elements. Optical measurement of temperatures for control purposes has not yet been applied at Trona. Dust makes use of optical systems difficult. When we come to flow, level, and density measurements, we feel that Trona has

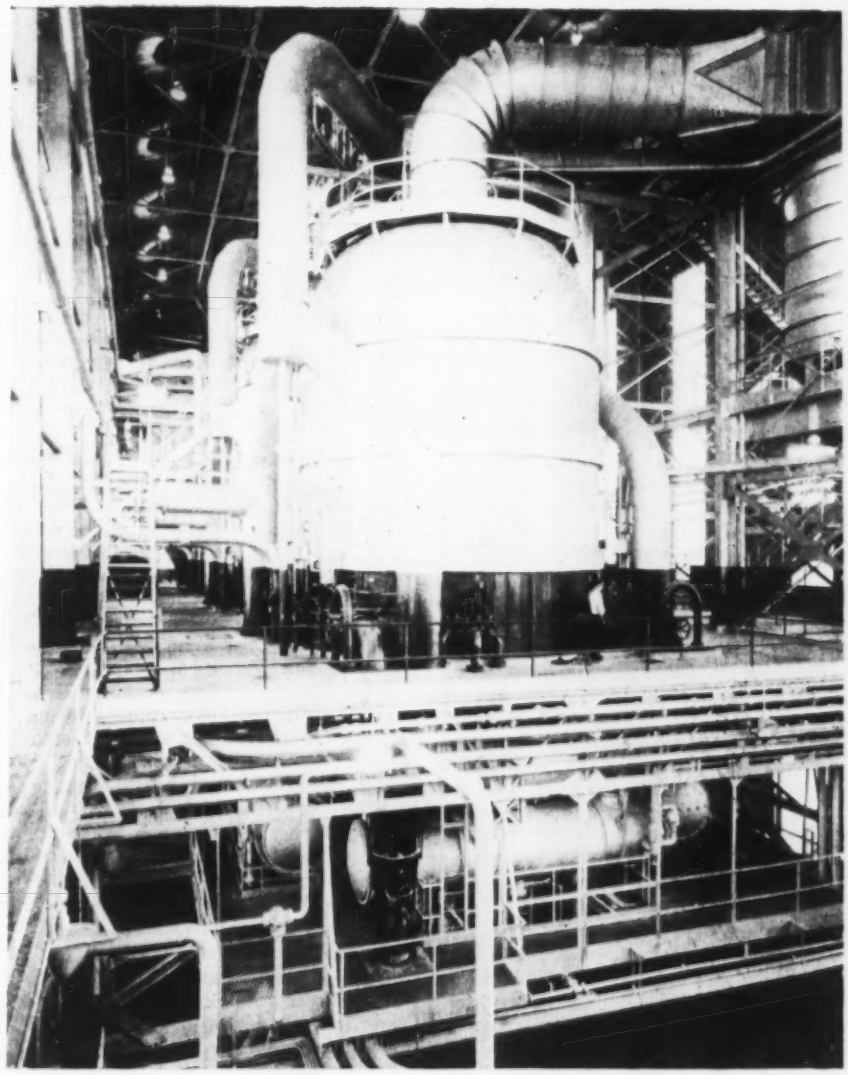


Fig. 5. One of Trona's three evaporating units. Note the man at right center to gain an idea of the magnitude of the operations.

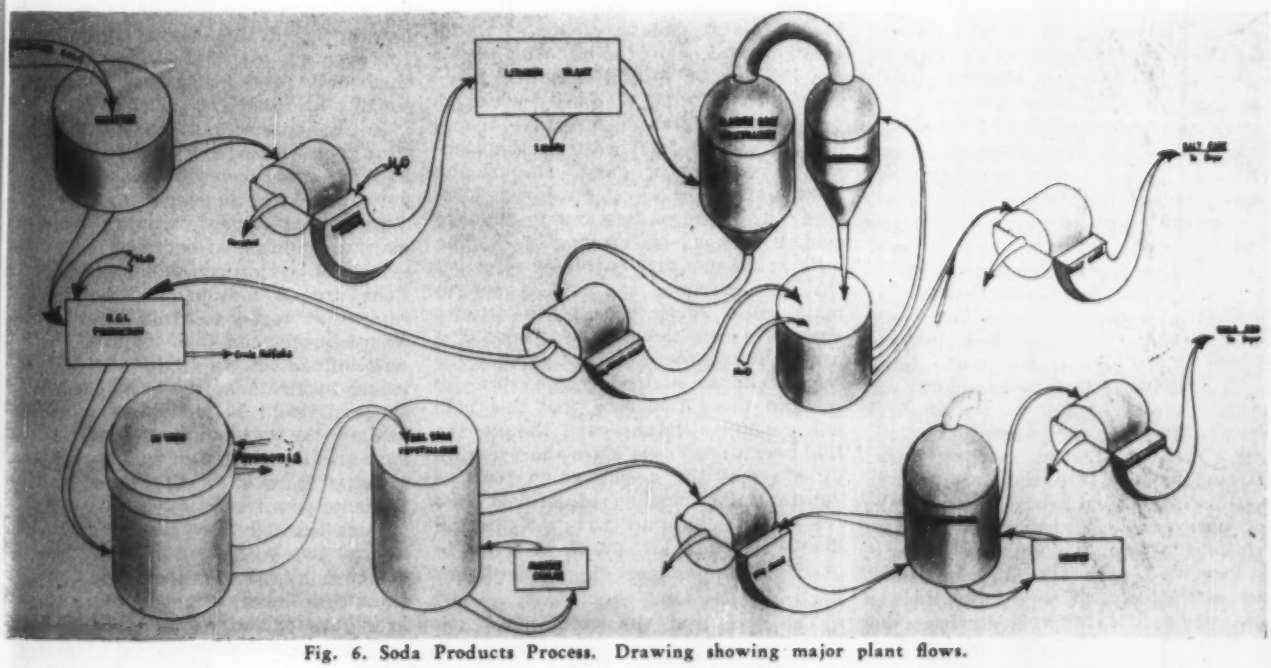


Fig. 6. Soda Products Process. Drawing showing major plant flows.

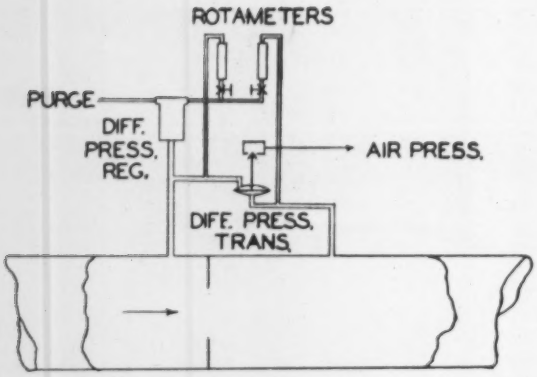


Fig. 7. Minimum purge low displacement orifice meter installation for applications to salting liquors, where dilution must be held to a minimum.

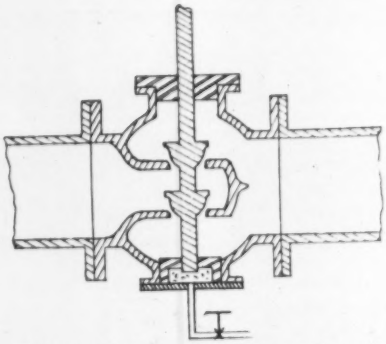


Fig. 8. Bottom-guided control valve, showing salt accumulation in bottom guide, and purge connection.

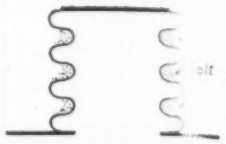


Fig. 9. Showing salting of re-entrant surfaces.

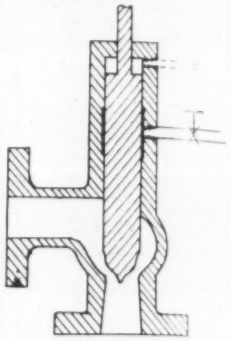


Fig. 10. Angle plug valve.

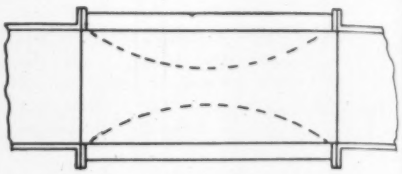


Fig. 11. Constriction valve.

some special problems. Most of our important liquid flows are saturated with materials in solution, and many are sludges containing the same materials in suspension. Whenever such liquids come to rest they settle out and also crystallize out, and they don't always have to come to rest. We have very fine or "crypto-crystalline" varnishes, or glazes, deposited in some of our pipes which can only be removed by acid washing. And we have massive crystal aggregations occurring where liquors are at rest which are harder than concrete. In addition to this, most of our liquors are corrosive, requiring 316 SS for resistance in most cases. In some cases even SS is seriously attacked. Brass and bronze will last long enough to turn one's back, and not much longer.

With such liquors, containing solids and likely to deposit salt, displacement type fluid meters have never been entirely successful. Generally speaking, we must not allow any "dead spots" at any point, no matter how small, for we have found by bitter experience they will soon fill solid with salt. Nor can we use devices with moving parts in contact with the metered fluid—the varnishes soon build up and "freeze" the meter. One early method was the use of volume tanks in pairs, filling one while the other emptied, but this required a man to switch the flows, and was abandoned. Another disadvantage lay in the fact that salt built up in the tanks and decreased their effective volume. Fairly extensive use of weirs was practiced at one time and many weirs are still in service. Salt seems to be cleaned from the weir edge as it is formed, but it does form deposits in the weir box, and also above the liquor level because of splashing. Since we have many flows entering closed vessels for cooling and heating, weirs are not applicable at most of our metering points, and recorders are not used on them.

Orifice meters are the most widely used type in Trona at the present time. On water and lake brine service they are satisfactory. Lake brine, while it is saturated with six different salts, gives relatively little trouble due to salting, but even on this service a lot of attention is required to maintain reasonable accuracy. When we move into the plant and attempt to meter hot saturated plant liquors, our troubles begin in earnest. Solid material flowing along the pipe builds up in front of the orifice plate, and what started as an orifice meter becomes a sort of hybrid Venturi tube. Salt deposits forming along the pipe walls decrease the effective inside diameter of the pipe at a more or less continuous but unpredictable rate. Attempts to reduce salting troubles by means of steam jackets have not been successful so far, because we have compounds exhibiting "inverse solubility" so that a coating forms on heated surfaces too. Other things failing, some day we may try to control meter-run steam jackets neither to heat nor cool, by means of a temperature difference controller.

Sudden changes in flow rate result in changes of displacement in the meter, forcing salted liquors into one tap or the other, where they come to rest and fill the tap and pressure line with a solid deposit of salt. We might use a high rate of water purge, but dilution of these liquors costs money in terms of lost production. Seal pots are in service at some points, using oil as a transmitting fluid, but these salt up too, unless an excessive rate of water purge is used below the oil. At present, the problem of salting taps and pressure lines is being attacked by use of pneumatic differential pressure transmitters of the least possible displacement—types using small diaphragms as actuators for air pilot valves. Coupled with these we are trying a purge system such as shown in Fig. 7. The differential pressure regulator refers to the high-pressure tap and is set to maintain a purge pressure a definite amount above the line pressure. The needle valves can then be adjusted for the minimum desired purge rate by reading the rotameters, and this rate will remain constant even though the line pressure varies, since the pressure drop across the needle valve remains substantially unchanged. Since the transmitter has an extremely small displacement, a low purge rate can be used without danger of getting liquor back into the taps.

The fact that we seldom find evidence of coating on weir lips or orifice edges has led us to install an experimental constant-head type of meter in one of our worst locations. The thought behind this move is that the flow will be fastest at the point where the float is located, and so the coating troubles should be reduced to a minimum, both on the float and on the wall of the meter at float level. Also, in the Rotosleeve type of meter which we are testing, both the float and the tube are surrounded by hot liquor, and salting is thereby reduced. We anticipate having to acid wash this meter at times in order to remove a complex lithium-containing varnish. However, we feel encouraged because we have now operated this meter continuously for over six months, using one water wash daily, and we have obtained reasonable accuracy.

In an operation such as ours at Trona, the main control action lies in valving, whether we are controlling flows, levels, or temperatures. In handling salted liquors, valving presents many problems. Generally speaking, salting is less of a problem where solutions are in motion, and in all our equipment we try to avoid "dead spots" where liquors can come to rest. In the case of a bottom-guided double-port valve, for instance, less than a shift's run can result in a solid plug of salt locking the valve in either closed or open position. Of course, the simplest solution is to allow the worst salting liquor to flow freely and adjust a water or unsaturated flow to conform, and we use this where possible. Where we must use a bottom-guided type of valve on salting liquors we purge it as shown in Figure 8, and we have such valves in operation. The price is eternal vigi-

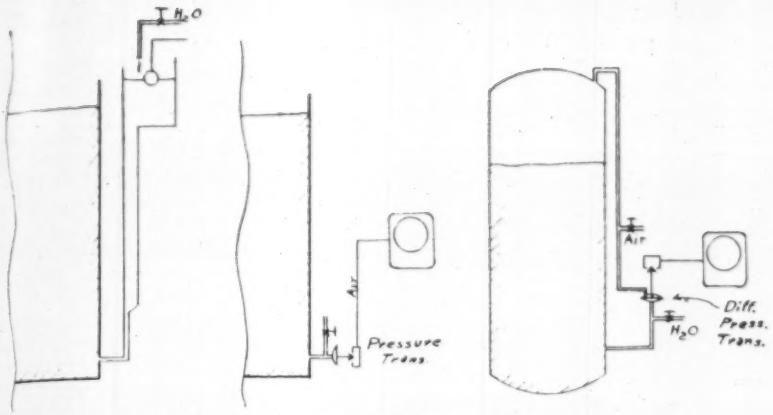


Fig. 12 Level measurement systems.

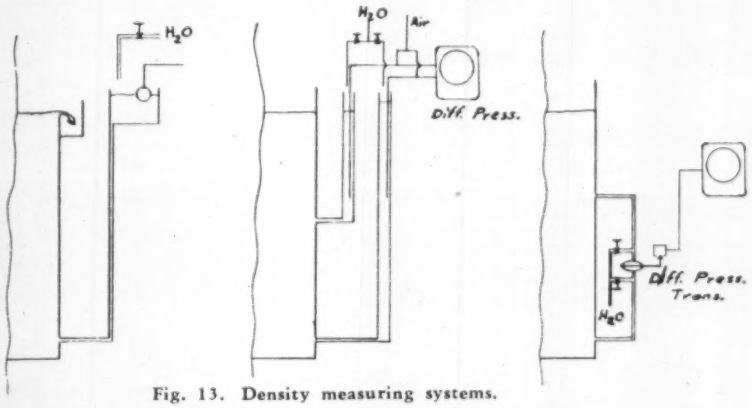


Fig. 13. Density measuring systems.

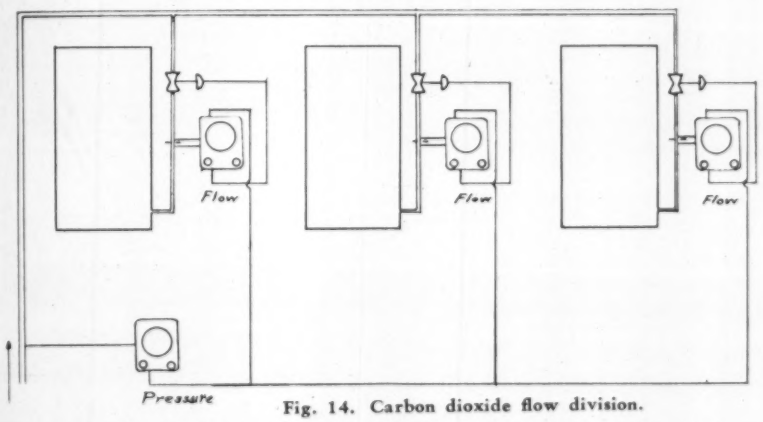


Fig. 14. Carbon dioxide flow division.

lance to make sure the purge is continuous. Currently we are experimenting with diaphragms as seals for the upper and lower guides in order to stop salting. Bellows seals may be expected to salt in their re-entrant portions, as shown in the sketch, Fig. 9, with consequent rupture.

Greatest success to date with conventional valve types has been ejoyed with single seat angle-plug types of valves, such as shown in Fig 10, but even here we must purge the top of the plug in order to prevent deposition of salt, and we have some trouble with varnish on the plug. The butterfly type of valve with its straight-through flow is expected to find wide application.

Probably our most satisfactory valve to date is a locally-developed one consisting of a straight run with flexible sides. See Fig. 11. The flow is adjusted by causing the sides to squeeze in. This valve tends to keep itself clean when used for control work since the flexing loosens salt deposits and they are swept downstream. However, at present the valve is limited in the temperatures at which it can be used, and has piping limitations as well. I am not prepared to give any further details on this valve, but the principle of straight-through flow, coupled with constricting surfaces, appears promising. The Saunders type of valve suffers excessive abrasion of its diaphragm in service on flows carrying solids, possibly because of the change of flow direction within the valve.

In the measurement of levels we have difficulty with floats and float-actuated devices, because of formation of salt deposits from the saturated liquors. Some quite massive floats have been used at times in an attempt at moving control valves by lever arrangements, but in almost all cases they have been unsatisfactory. Salt forming on the floats changes their buoyancy and splash salts up the lever systems. Air bleeds or bubblers in the salting solutions are rapidly plugged by reason of cooling and drying effects where the air enters the solution. We use three main methods of level indication for control purposes. See Fig 12. The first, used where dilution is not critical, is simply a column of water balanced against the column of solution in the tank. By using a continuous stream of water down the stand-pipe we insure purity of the column, and we can read its level by float or bubbler. The second method uses a pressure transmitter, allowing us to reduce the purge required, and lending itself readily to remote indication or recording. The third method uses a differential pressure transmitter, and is applied to closed vessels.

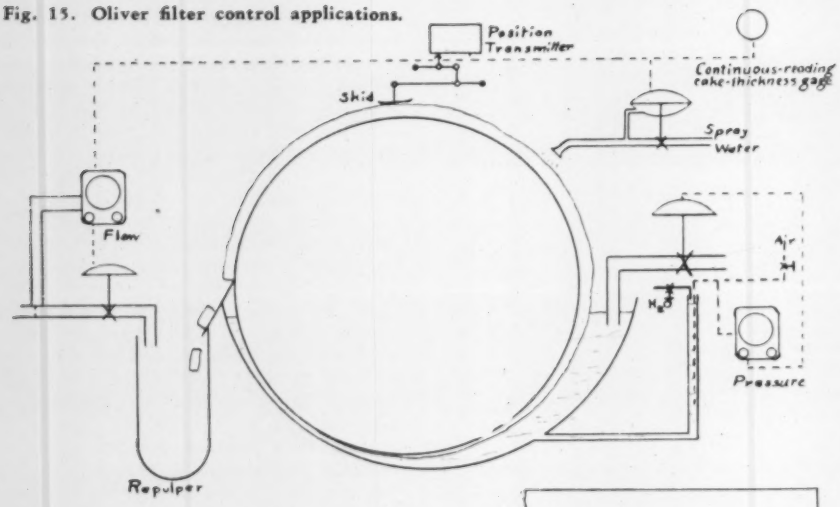
For measurement of liquid densities the matter of salting again rules out displacement or float type measurement. We use three main types of primary systems as sketched in Fig. 13. In the first, a column of water is balanced against a constant (overflowing) head of the liquor concerned, and we can read density by means of a float or bubbler. In the second method two columns of water are balanced against different heights of the liquor and the difference in elevations of water surface represents the density of the liquor. By varying the distance between taps and the depth of immersion of the bubble tubes used for level measurement we can get a variety of density scales. The third method is a variation of the second, using a differential pressure transmitter.

Since I am trying to present items more or less peculiar to operations such as Trona, I will ignore combustion controls, which are more or less of standard type. We have a few other control applications which I think may interest you. These are solutions which we have worked out for ourselves, and I will outline five.

In one problem (see Fig. 14) we were required to divide a flow of carbon dioxide between three bubble carbonation towers with the further specification that the operator be able to vary the proportions to the various towers. This has been done by using three adjustable pneumatic-set flow controllers, one to each tower. The set points of these controllers are adjusted by the control pressure from a pressure controller on the CO_2 supply line. When the supply of CO_2 increases, the pressure rises and the control pressure from the pressure controller raises the control indexes of the flow controllers, increasing flow to the towers, with the reverse action occurring when supply falls off. In order to vary the distribution of gas, the operator adjusts the relative amounts of index movement in response to pressure change on the flow controllers.

Fig. 15 shows several of our devices

Fig. 15. Oliver filter control applications.



fitted on an Oliver rotating drum filter. To the left I have sketched a water-column type level control system maintaining bowl level by controlling the filter feed valve on the basis of bubble tube pressure readings. On top the drum is a skid riding the cake, and the position transmitter sends an air pressure proportional to cake thickness to an indicating gage. The same pressure regulates the spray water pressure for cake wash through a balanced pressure-reducing valve, automatically varying the wash to suit cake thickness. This pressure also sets the control index for the repulping medium flow controller, automatically varying the flow of repulper medium according to cake thickness.

Not all these systems are in use on any one filter, but they have all been successfully applied at Trona. The two-lever system sketched has been used on the spray pressure control, since by varying the angles of the levers we can change from linear pressure transmission to a more suitable characteristic of transmitted pressure.

The problem to which Fig. 16 pertains was to measure the expansion of a rotating drum which might be warped, and to control fire to hold this expansion at a constant value. The fact that the drum might be warped made use of a roller undesirable since it would give an unsteady reading. We decided to measure at one point on the drum, and hold this measurement during the rest of the rotation, so that warping would not result in an unsteady indication. As the guide wings come around each revolution, they position the feeler bar which is held steady by a friction lock on its mounting plate while not engaged in the guide. The feeler bar is attached to a pneumatic position transmitter and the length of the drum appears as an air pressure corrected once each revolution. This pressure is sent to a recording pressure controller calibrated to read in inches of expansion, and this controller handles the fire. While we originally hoped to control expansion of an eighty-foot drum to 4 inches plus-or-minus

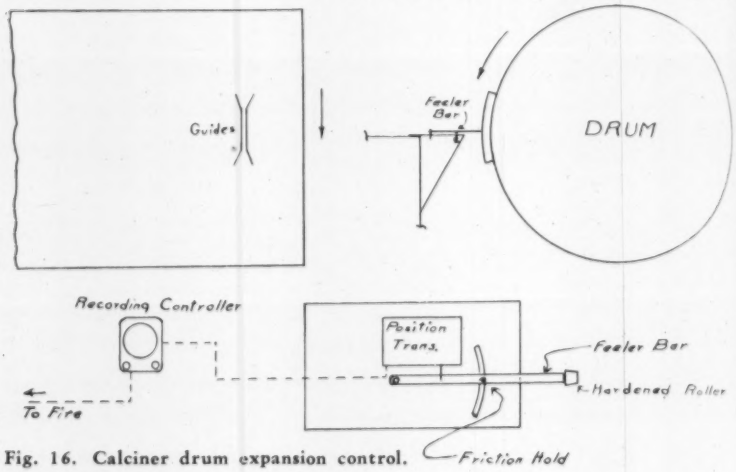


Fig. 16. Calciner drum expansion control.

0.25 inch, we have little trouble in controlling to plus-or-minus one-tenth of an inch.

Fig. 17 represents a solution to the problem of ratioing small quantities of flotation oil to a widely varying flow of liquid. Capacities are large here, but there seemed little chance of directly measuring either the input to the system or the results of oil addition. However, the dilution is automatically controlled to a constant density, and measurement of the dilute flow can give us a measure of the input to the system. Control has been established by the use of an orifice in an overflow launder and a varying head of oil behind another orifice. Referring to Fig. 17, the head of liquor in the launder behind the orifice is proportional to the square of the flow rate. The differential pressure controller measures this head by means of the bubble tube and standpipe, and adjusts the oil level in the standpipe to an equal value. Flow of oil through the small orifice is proportional to the square root of the head, and hence directly proportional to the flow of liquor. The ratio is adjusted by changing orifice size.

I have tried to give an insight into some of our problems at Trona and some of our solutions. Automatic control is not well established in our industry. Attempts at control have been made at times without full appreciation of some of our peculiar require-

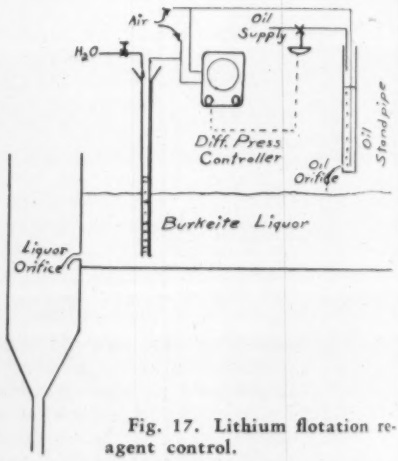
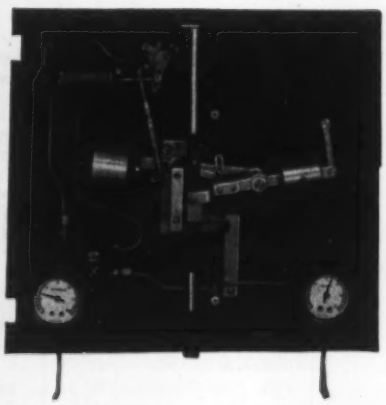


Fig. 17. Lithium flotation reagent control.

ments; and, since failures are always more prominent than successes, there are some who are inclined to scoff at automatic control. I believe in it myself. But where we have such conditions as I have outlined I don't believe that we can depend on manufacturers' representatives for all our solutions, because they are not acquainted with some of our peculiar plant problems. I don't think any control problem can be solved by a technically-trained man acquainted with both plant problems and the products of many instrument manufacturers. There is a standard item of equipment in somebody's catalog for almost any conceivable operation or requirement. In our work we try to recognize new applications of standard items in new combinations. And so we sometimes mix different manufacturers rather intimately. We think we are in a better position to do this than any one manufacturer's representative —who must push his own line—and we feel that by so doing we realize potentialities from the individual instruments which might otherwise remain ignored. And I am convinced that we will some day have automatic-control systems as complete and as satisfactory as found in any refinery or other plant. I expect difficulty, but I feel that the field of chemical process control has only been scratched. The future holds success for the user and a great deal of interest for the engineer.



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Manufacturers' New Literature

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R-661 INDUSTRIAL INSTRUMENTS. 16-page bulletin describes and illustrates maker's pyrometers and alarm systems, salinity indicators and alarm, tachometers, electromagnetic balance, "Q" balances, operation recorders, level indicators, etc.; lists specifications.—The Instrument Laboratory Inc., 926-34 Elliott Ave. W., Seattle 99, Wash.

R-662 AUTOMATIC CONTROL. 12-page Bulletin No. 6148 illustrates and describes maker's custom-built electrical process control panels; lists types, structural features; discusses example problems and solutions.—Process Control Div., Richardson Scale Co., Clifton, N. J.

R-663 BALANCING MACHINE. 6-page bulletin describes and illustrates maker's "HI-EFF" balancing machines; lists capacities, uses, advantages.—Taylor Dynamometer & Machine Co., 5108 W. Center St., Milwaukee 10, Wis.

R-664 "hp JOURNAL." 4-page Vol. 1 No. 1 issue of this house organ presents article titled "A New Amplifier for Milli-microsecond Pulses"; lists specifications.—Hewlett-Packard Co., 395 Page Mill Rd., Palo Alto, Calif.

R-665 VOLTAGE-DIVIDING RESISTOR. 6-page bulletin illustrates and describes maker's "Type RV2" high-precision voltage-dividing resistor; gives special features, dimensions, specifications.—Technology Instrument Corp., 1058 Main St., Waltham 54, Mass.

R-666 DYNAMOMETERS. 4-page Bulletin 760 describes and illustrates maker's "HI-EFF" hydraulic dynamometers; gives uses, specifications, capacities.—Taylor Dynamometer & Machine Co., 5108 W. Center St., Milwaukee 10, Wis.

R-667 RELAY CATALOG. 12-page Catalog D-20A describes and illustrates maker's sensitive, midget metal base, heavy-duty midget, etc., relays; gives general information, capacities.—Ward Leonard Electric Co., Mount Vernon, N. Y.

R-668 RADIO TUBE TECHNICAL MANUAL. 86-page technical manual in plastic ring binder describes and illustrates maker's new tube types; gives specifications, ratings, typical operations, applications. Price 85 cents.—Sylvania Electric Products, Inc., Emporium, Pa.

R-669 INDUSTRIAL PROCESS INSTRUMENTS. 4-page bulletin illustrates and describes maker's recording thermometers, air-operated controllers, self-operating temperature controllers, etc.; gives applications, dimensions.—Leland Instrument Co., 520 East Larned, Detroit 26, Mich.

R-670 SPLIT-CORE VOLT-AMMETER. 4-page Catalog No. 109 describes and illustrates maker's "Amprobe" pocket-sized volt-ammeter; gives specifications, uses, special features.—Pyramid Instrument Co., 49 Howard St., New York 13, N. Y.

R-671 CHLORINIZER. 2-page Bulletin 840-F3T illustrates and describes maker's "Gravimetric Model CGS" chlorinizer; lists features; contains schematic flow diagram.—Builders-Providence, Inc., Providence 1, R. I.

R-672 LINEAR-ACTUATION VOLTAGE-DIVIDERS. 2-page bulletin describes and illustrates maker's "Types A and B Rectipots"; lists features, specifications.—G. M. Giannini & Co., Inc., 254 W. Colorado St., Pasadena 1, Calif.

R-673 SOLDERING IRONS. 2-page Catalog No. 514 illustrates and describes maker's industrial electric soldering irons; lists sizes, specifications.—Electric Soldering Iron Co., Inc., Deep River, Conn.

R-674 SPLASH-PROOF SWITCH. 2-page Data Sheet No. 55 describes and illustrates maker's "OP-AR50" splash-proof switch with plate actuator; discusses parts; lists characteristics, electrical rating.—Micro Switch, Freeport, Ill.

R-675 SOLENOID AIR VALVES. 4-page Folder-S illustrates and describes maker's solenoid operated valves for air pressures of 0 to 125 psi.; lists features, specifications.—Valvair Corp., 454 Morgan Ave., Akron 11, Ohio.

R-676 MULTIPLIER PHOTOTUBE. 8-page technical bulletin describes and illustrates maker's "Head-on Type 5819" multiplier phototube; lists characteristics; discusses installation, application.—Tube Dep't., Radio Corporation of America, Harrison, N. J.

R-677 RADIOACTIVITY MEASUREMENT. 8-page bulletin illustrates and describes maker's "Raychronometer" scaling instrument for measuring radioactivity with Geiger tubes; lists special features, characteristics, specifications.—Radioactive Products, Inc., 3201 E. Woodbridge St., Detroit 7, Mich.

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R-685 ELECTRONIC INSTRUMENTS. 12-page Bulletin 231-A describes maker's electronic type instruments for temperature, pressure, flow, etc.—gives outstanding features, circuit diagrams, applications.—Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland 10, Ohio.

R-686 STEEL FABRICATION. 8-page bulletin describes steel assemblies and sub-assemblies, instrument mounting structures, panels, control boards, cabinets; shows samples.—Falstrom Co., Passaic, N. J.

R-687 PRESSURE CONTROL PILOT. 8-page Bulletin No. 150 describes maker's "Pilot No. 1500" for automatic control of pressure; lists types of service, operating pressures; discusses operation.—McAlear Manufacturing Co., 1901 S. Western Ave., Chicago 8, Ill.

R-688 INDUSTRIAL MICROSCOPE. 2-page bulletin describes maker's "Model 23" industrial microscope; lists attributes, specifications; sample photomicrographs.—Clarkstan Corp., 11927 West Pico Blvd., Los Angeles 34, Calif.

R-689 RADIOACTIVITY DETECTORS. 4-page bulletin describes maker's G-M and proportional counters, and ionization chambers for detecting alpha, beta, gamma, and x-rays, and neutrons; lists features, specifications, uses.—N. Wood Counter Laboratory, 5646 Harper Ave., Chicago 37, Ill.

R-690 HERMETICALLY-SEALED RELAYS. 4-page Bulletin 104 describes maker's plug-in, solder terminal, AN-connector-type hermetically-sealed relays; lists specifications, features, uses.—Leach Relay Co., 5915 Avalon Blvd., Los Angeles 3, Calif.

R-691 ROTARY ACTUATORS. 6-page bulletin describes maker's rotary actuators; lists design, performance statistics, applications; contains diagrammatic sketches.—Lear, Inc., 110 Ionia Ave., N. W., Grand Rapids 2, Mich.

R-692 MICA-WINDOW COUNTER. 2-page bulletin describes maker's "Mark 1 Model 3" fusion-seal mica-window counter; lists features, specifications.—Radiation Counter Laboratories, Inc., 1844 W. 21st St., Chicago 8, Ill.

R-693 UNIVERSAL D-C. AMPLIFIER. 2-page bulletin describes maker's "Type DCA-3" universal d-c. amplifier; lists features, applications, operation data.—Millivac Instruments, P. O. Box 3027, New Haven, Conn.

R-694 INSTRUMENT HOUSING. 8-page bulletin describes maker's weatherproof and portable instrument houses, safety heater, starting wheel, mercury protectors; lists features, uses.—Moran Furnance & Sheet Metal Co., 807 E. Fifth Place, Tulsa, Okla.

R-695 FLOAT VALVES. 4-page bulletin describes maker's direct-acting, pilot control, single- and double-seated float valves; lists features, uses, dimensions.—O. C. Keckley Co., 400 W. Madison St., Chicago 6, Ill.

R-696 "TAYLOR TECHNOLOGY." 32-page Vol. 2, No. 2 issue of this house organ presents articles titled "Instrumentation Reduces Complex Multiple Cycle Textile Dyeing Process to 'Push-Button' Operation," "Dynamic Accuracy in Temperature Measurement," and others.—Taylor Instrument Cos., Rochester 1, N. Y.

R-697 COMPOUND MICROSCOPE. 4-page bulletin describes maker's (Pan-Technics, Ltd.) "Pantechniscope" unitized compound microscope for educational or professional use; lists features, magnification.—Cal-Astro Optical Laboratories, 711 N. Lake Ave., Pasadena 6, Calif.

R-698 "SPECTROGAPHER'S NEWS LETTER." 4-page Vol. II, No. 12 issue of this house organ discusses maker's new 1.5-meter grating spectrograph; contains article titled "New Procedures in Non-metallic Sample Analysis." 4-page Vol. III, No. 1 issue discusses accessories to maker's 1.5-meter grating spectrograph; contains article titled "Semi-quantitative Factors for Uranium and Thorium."—Applied Research Laboratories, 4336 San Fernando Rd., Glendale 4, Calif.

R-699 WEIGHT CONTROL, ETC. 30-page catalog describes maker's weight indicators, drilling controls, rotary tachometers; lists parts, prices.—Martin-Decker Corp., 3431 Cherry Ave., Long Beach 7, Calif.

R-700 SPECTROGRAPH. 4-page bulletin describes maker's "No. 6200" 1.5-meter spectrograph; discusses construction, features; lists specifications.—Applied Research Laboratories, 4336 San Fernando Rd., Glendale 4, Calif.

R-701 DENSITOMETER. 4-page bulletin describes maker's sound-track densitometer; discusses operation, applications.—Photovolt Corp., 95 Madison Ave., New York 16, N. Y.

R-702 CONTROL VALVES. 12-page Bulletin 103 describes maker's control valves; lists operation, performance statistics.—Paul Valve Corp., 683 Third Ave., New York 17, N. Y.

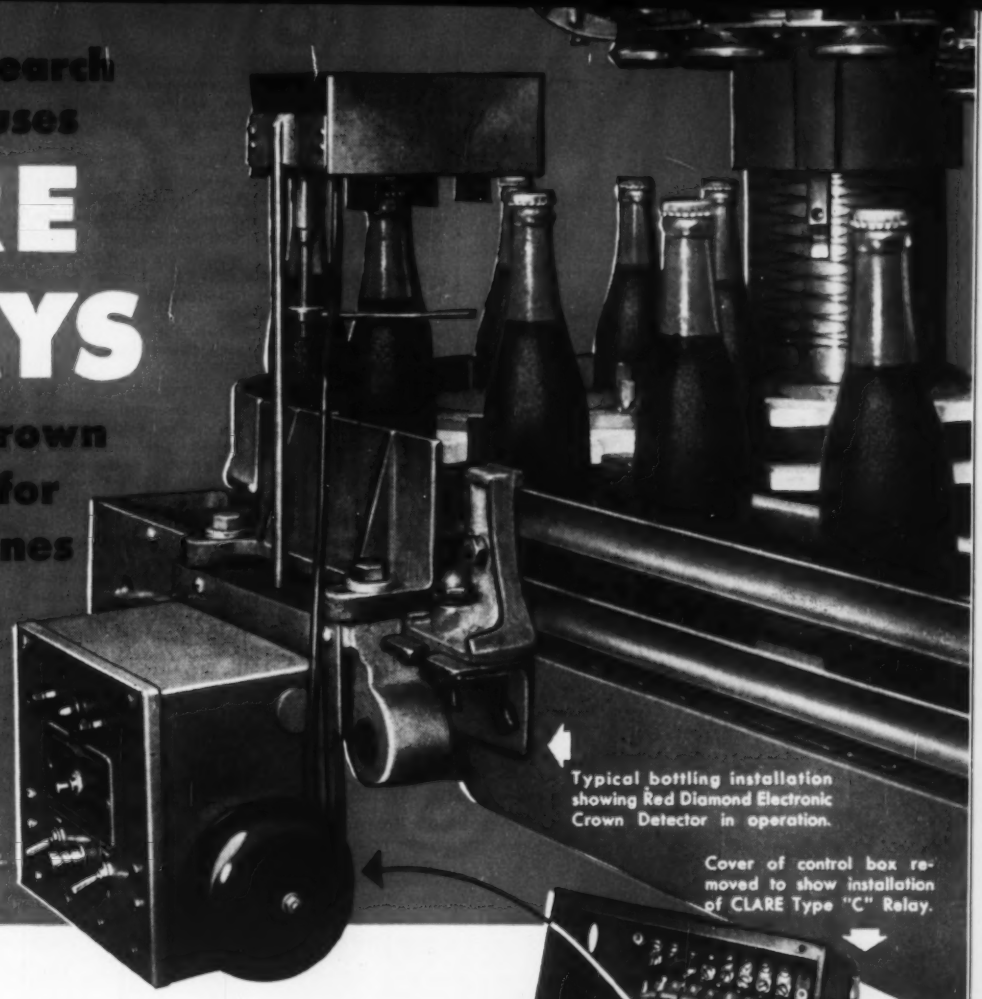
R-703 COLOR MEASUREMENT. 2-page bulletin describes maker's "Model 610" photoelectric reflection meter for color printing control; lists features, accessories; discusses operation.—Photovolt Corp., 95 Madison Ave., New York 16, N. Y.

R-704 COMBUSTION CONTROL. 8-page

Industrial Research Laboratories uses

CLARE RELAYS

in Electronic Crown Detector Unit for Bottling Machines



Typical bottling installation showing Red Diamond Electronic Crown Detector in operation.

Cover of control box removed to show installation of CLARE Type "C" Relay.

Send for CLARE Engineering Data Book

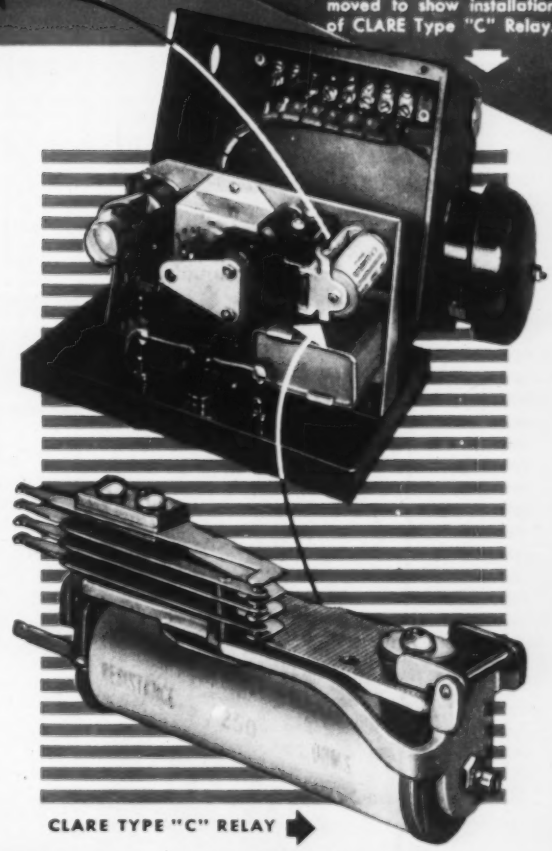
This book, sent on request, pictures and describes the complete CLARE line of relays and allied control apparatus to meet the widest variety of industrial uses.

This electronic device warns of any interruption of the crown supply in bottling operations. It is sold by Liquid Carbonic Corporation of Chicago and manufactured by Industrial Research Laboratories of Baltimore, Md.

A bottle feeler switch is inserted in the control grid circuit to close the circuit when a bottle passes between the poles. If a crownless bottle passes, an electronic tube momentarily operates the CLARE Type "C" Relay and an alarm sounds for a few seconds. Passage of the second crownless bottle causes the CLARE relay to stop the machine on the second operation.

CLARE relays were selected by Industrial Research Laboratories for this important operation because of their long reputation for accurate, long-life performance as components of devices designed for trouble-free operation, day in and day out. In larger plants, more than a million bottles per week pass through the machine.

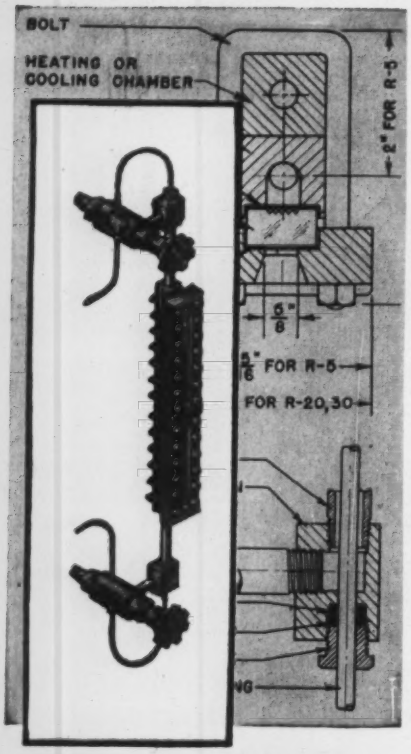
If you have a difficult relay problem, a requirement where ordinary relays just won't do, why not take it up with our engineers? CLARE sales engineers are located in principal cities. They are experienced in the most difficult types of relay problems. We invite you to take advantage of their services. Call them direct . . . or write to C. P. Clare, 4719 West Sunnyside Avenue, Chicago 30, Illinois. In Canada: Canadian Line Materials Ltd., Toronto 13. Cable address: CLARELAY.



CLARE TYPE "C" RELAY

CLARE RELAYS

First in the Industrial Field



JERGUSON HEATED AND COOLED GAGES
Give Accurate Readings Under All Conditions

USE Jerguson Heated Gages for accuracy if you are dealing with high viscosity liquids that flow sluggishly.

On the other hand, if you are dealing with highly volatile liquids which tend to boil, use Jerguson Cooled Gages with circulating cooling medium.

In either case, Jerguson engineers have the answer, with a complete line of gages that give accurate reading of *all* liquids under *all* temperature conditions.

Jerguson Heated-Cooled Gages are made in internal tube and double chamber models for all pressures.

Illustration shows Internal Tube Model, Reflex Type, with No. 93 Valves. Write for Data Unit No. 17.

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Bulletin No. 103 describes maker's "Robot-Eye" combustion control for hydrocarbon-fuels firing; gives typical installations, application tables.—General Power Plant Corp., 381 Fourth Ave., New York 16, N. Y.

R-705 VISUAL INSPECTION INSTRUMENT. 2-page bulletin describes maker's "Inspector" fluorescent-lighted visual inspection equipment; lists features uses.—Larrimore Sales Co., Box 1234, Central Station P. O., St. Louis 1, Mo.

R-706 AIR FILTER-DRYER. 4-page bulletin describes maker's "Condensifilter" for dry, clean, oil-free compressed air; discusses construction, operation; lists specifications.—Hankison Corporation, 1501 Beaver Ave., Pittsburgh 12, Pa.

R-707 COMBUSTIBLES RECORDER. 16-page Bulletin No. 150-A describes maker's combustibles recorder for boiler furnaces, industrial furnaces, chemical processes, etc.; discusses features, applications, performance.—Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland 10, Ohio.

R-708 TEMPERATURE REGULATORS. 8-page Bulletin 329 describes maker's "Series No. 11" self-operating regulators for temperature control of liquids and air; lists uses, specifications, dimensions.—The Powers Regulator Co., 2720 Greenview Ave., Chicago 14, Ill.

R-709 AIR CONTROL VALVES. 4-page Folder-A describes maker's air control and solenoid valves; lists features, uses.—Valvair Corp., 454 Morgan Ave., Akron 11, Ohio.

R-710 HIGH-VACUUM APPARATUS. 50-page Bulletin 10A describes maker's high-vacuum pumps and accessories; discusses "Planning the High Vacuum System."—Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.

R-711 PRECISION LATHES. 4-page Bulletin F describes maker's precision lathes for small parts and fine tool work; lists features, dimensions.—Louis Levin & Son, Inc., 782 E. Pico Blvd., Los Angeles 21, Calif.

R-712 PHOTOELECTRIC COLORIMETER. 4-page Bulletin B-214 describes maker's "Model 8" photoelectric colorimeter; lists features, types.—E. Machlett & Son, 220 E. 23rd St., New York 10, N. Y.

R-713 VOLTAGE CONTROL. 4-page bulletin describes maker's "Variac" autotransformers for voltage control; lists features, specifications.—General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.

R-714 INSTRUMENT PANELS, CUBICLES. 12-page bulletin describes maker's instrument panels, cubicles, cabinets; gives design, engineering details, specifications.—Falstrom Co., Falstrom Court, Passaic, N. J.

R-715 ZIRCON REFRACTORY WARE. 18-page catalog describes maker's zircon base refractory ware; lists properties, sizes, prices.—Laboratory Equipment Corp., St. Joseph, Mich.

R-716 SELENIUM RECTIFIERS. 8-page Bulletin DB-19-025 describes maker's standard and high-voltage selenium rectifiers; lists features, characteristics, efficiency curves.—Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

R-717 AIR CIRCUIT BREAKERS. 8-page Catalog 2550 describes maker's "Type RS" air circuit breakers; lists application, features, characteristics.—Roller-Smith, 1766 N. Market St., Bethlehem, Pa.

R-718 "CEC" RECORDINGS." 4-page Vol. 3, No. 3 issue of this house organ features article titled "Oscillograph Data Aid Engineers in Design of New Oil Well Pump"; contains other articles on maker's equipment.—Consolidated Engineering Corp., 620 N. Lake Ave., Pasadena 4, Calif.

R-719 ELECTROMETRIC TITRIMETER. 4-page bulletin describes maker's "Improved Senior" electrometric titrimeter; discusses features, uses; lists accessories.—Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.

R-720 STRAIN GAGE CATALOG. 12-page catalog describes maker's "SR-4" strain gages; contains price list, specification table; lists accessories.—Testing Equipment Dep't, The Baldwin Locomotive Works, Philadelphia 42, Pa.

R-721 "CURRENTLY." 8-page Vol. 3, No. 1 issue of this house organ features articles titled "Nobatron to Regulator," "Overcoming Voltage Drop," "Engineering Notes [illegible] Adolph"—Sorensen & Co., Inc., 375 Fairfield [illegible], Stamford, Conn.

R-722 ELECTROCHEMOGRA[illegible]. 4-page folder describes maker's "Type E" electrochemograph for polarographic analyses; discusses features, performance.—Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.

R-723 ROTARY COUNTERS. 2-page bulletin describes maker's "Productimeter" rotary counters; lists features, applications.—Durant Mfg. Co., 1990 N. Buffum St., Milwaukee 1, Wis.

R-724 AIR-OPERATED CONTROLLERS. 4-page bulletin describes maker's "Series 500" air-operated controllers; lists features, uses.—The Bristol Co., Waterbury 91, Conn.

R-725 HIGH TEMPERATURE TUBES. 2-page bulletin describes maker's "Triangle H5" impervious mullite pyrometer sheaths, combustion tubes; lists features, sizes.—Morganite, Inc., 3302 48th Ave., Long Island City 1, N. Y.

R-726 RECORDING PAPERS. Two booklets 4-page and 12-page, describe maker's recording papers; discuss use with various recorders.—Alfax Paper & Engineering Co., 39 Riverside Ave., Brockton, Mass.

R-727 LIQUID-LEVEL CONTROLLERS. 4-page bulletin describes maker's "Magneswitch" liquid-level controllers; lists characteristics, special features.—Jo-Bell Products, Inc., 4820 So. St. Louis Ave., Chicago 32, Ill.

R-728 CONSTANT-VOLTAGE TRANSFORMERS. Two 2-page bulletins, CVH-136 and CVE 138, describe maker's "Type CVH" for constant voltage with low harmonic distortion, and "Type CVE" constant voltage power supply transformer; both list characteristics, dimensions—Sola Electric Co., 4633 W. 16th St., Chicago 50, Ill.

R-729 GLASS CYLINDERS. 4-page catalog describes maker's line of glass cylinders for industrial use; lists types, prices.—Dunbar Glass Corp., Dunbar, W. Va.

R-730 AIR-MOVEMENT GAGES. 2-page Bulletin No. 250 describes maker's "Magnehelic" supersensitive pressure gages for checking air movement; discusses features, construction.—F. W. Dwyer Mfg. Co., Chicago 12, Ill.

R-731 ORIFICE FITTINGS. 6-page Bulletin 48 CN describes maker's "Type CN" orifice fittings; discusses features, installation, applications.—Commercial Iron Works, 2424 Porter St., Los Angeles, Calif.

R-732 PLUG-IN AMPLIFIERS. 2-page bulletin describes maker's subminiature audio-frequency plug-in amplifiers; lists features, specifications.—The Walkirt Co., 5808 Marilyn Ave., Culver City, Calif.

R-733 AUTOMATIC SHUT-OFF VALVES. 2-page bulletin describes maker's pressure-operated automatic shut-off valves; lists characteristics, features—Security Valve Corp., 410 San Fernando Rd., Los Angeles 31, Calif.

R-734 INSTRUMENT HOUSING. 2-page bulletin describes maker's "Tilt Back" orifice meter house; gives dimensions, assembling instructions.—Gordon Z. Greene Co., 2335 E. 8th St., Los Angeles 21 Calif.

R-735 TIME CONTROL DEVICES. 28-page bulletin describes maker's time-delay relays, repeat-cycle timers, interval timers, etc.; lists features, specifications, uses.—The A. W. Haydon Co., Waterbury 32, Conn.

R-736 METERING PUMPS. 4-page Bulletin No. 1 describes maker's metering pumps; lists features, performance data.—Edward E. Robinson, Inc., 95 Park Ave., Nutley 10, N. J.

R-737 "HASTINGS INDICATOR." 8-page issue of this house organ features articles on maker's "Raydist" automatic ship-position plotting board, and other equipments.—Hastings Instrument Co., Inc., P. O. Box 1275, Hampton, Va.

R-738 THERMOWELLS. 44-page Catalog No. 200 describes maker's thermowells; gives specifications, dimensions.—Trinity Equipment Corp., 472 Westfield Ave. E., Roselle Park, N. J.

R-739 "GENERAL RADIO EXPERIMENTER." 8-page Vol XXIV, No. 5 issue of this house organ features articles titled "A Smaller 'Variac' Speed Control," "Returning Instruments for Repair."—General Radio Co., 275 Massachussetts Ave., Cambridge 39, Mass.

R-740 AIR VALVES. 12-page Bulletin AV100 describes maker's line of standard air valves

for remote control of single- and double-acting air cylinders; lists features, dimensions.—The Bellows Co., 222 W. Market St., Akron 9, Ohio.

R-741 RADIATION PYOMETERS. 12-page Bulletin P1242 illustrates and describes maker's "Pyrovisor" radiation pyrometers; gives principle of operation, typical applications, features.—The Bristol Co., Waterbury 20, Conn.

R-742 WATTHOUR METER TESTING ACCESSORIES. 12-page Cat. No. 1, Sec. 8F describes maker's meter-testing accessories, binding posts, terminal lugs, flexible cable, etc.; lists uses, specifications.—The States Co., Hartford, Conn.

R-743 "THE OHMITE NEWS." 2-page September issue of this house organ features articles on maker's resistors and other devices.—Ohmite Mfg. Co., 4835-41 Flournoy St., Chicago 44, Ill.

R-744 BATTERIES. 6-page bulletin describes maker's industrial, laboratory, radio and ignition batteries; contains specification sheet.—Specialty Battery Co., Madison 3, Wis.

R-745 TUNING-FORK RESONATORS. 12-page bulletin describes maker's tuning-fork resonators; discusses operation; lists specifications.—Philamon Laboratories, 5717 Third Ave., Brooklyn 20, N. Y.

R-746 MECHANICAL COUNTER. 2-page Bulletin G49-68 describes maker's "Duo Cam" counter; gives specifications, ordering instructions.—Veeder-Root, Inc., Hartford, Conn.

R-747 PORTABLE TACHOMETER. 2-page bulletin illustrates and describes maker's portable electric tachometer and portable hand tachometer; lists features, specifications.—The Electro-Mechano Co., Milwaukee, Wis.

R-748 STRAIN GAGE. 4-page Bulletin 279 describes maker's "SR-4" strain gage; discusses principle of operation, uses, material and construction—The Baldwin Locomotive Works, Philadelphia 42, Pa.

R-749 X-RAY SPECTROMETER. 2-page bulletin describes maker's X-ray spectrometer; discusses method of operation, uses.—Ohio X-Ray Inc., Rm 6, Bedford Savings & Loan Bldg., Bedford, Cleveland, Ohio.

R-750 DIRECT-RECORDING DISPLACEMENT GAGE. 2 page bulletin describes and illustrates maker's "Model BL-309" direct-recording displacement gage; lists features, specifications.—The Brush Development Co., 3405 Perkins Ave., Cleveland 14, Ohio.

R-751 MATERIAL TESTING. 4-page reprint "'Hypersonic' Non-destructive Material Testing" by H. B. Shaper discusses maker's method of detecting flaws in materials by supersonic means.—The Brush Development Co., 3405 Perkins Ave., Cleveland 14, Ohio.

R-752 QUICK-OPENING VALVE. 4-page Bulletin B-2 describes maker's reverse-acting quick-opening valve; gives dimensions, parts list.—The Valv-Trol Co., 167 Hill St., Akron 8, Ohio.

R-753 WEATHER INSTRUMENTS. 48-page Bulletin 9 describes maker's standard weather instruments; gives features, performance data, ordering information.—Friez Instrument Div., Bendix Aviation Corp., Baltimore 4, Md.

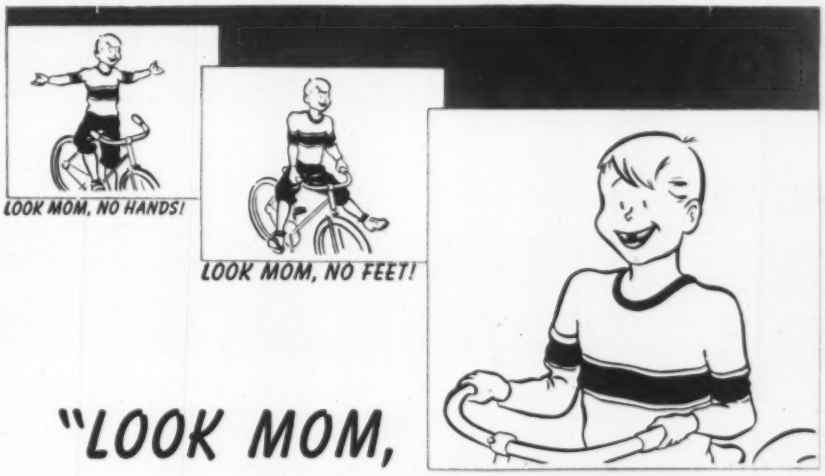
R-754 PYROMETER INDICATORS. 2-page Bulletin 25 describes and illustrates maker's multiple-point pyrometer indicators; lists features, available ranges.—Thermo Electric Co., Inc., Fair Lawn, N. J.

R-755 LIQUID-LEVEL CONTROL. 2-page Bulletin 9800 describes maker's "Prob-o-trol Type X" floatless controllers for chemical industries, food processing, etc.; lists features, applications, operation, specifications.—Automatic Control Co., St. Paul 4, Minn.

R-756 D-C AMPLIFIER. 2-page bulletin describes maker's "Model BL-913" direct-coupled amplifier for use with magnetic oscillograph; lists features, specifications.—The Brush Development Co., 3405 Perkins Ave., Cleveland 14, Ohio.

R-757 HYDRAULIC OPERATING VALVE. 4-page Bulletin A-1 describes maker's two-pressure hydraulic operating valve; lists features, parts list.—The Valv-Trol Co., 167 Hill St., Akron 8, Ohio.

R-758 TEMPERATURE AND HUMIDITY RECORDERS. 4-page bulletin describes maker's temperature and humidity recorders and indicators; lists features, capacities.—Friez In-



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Name of company on request.

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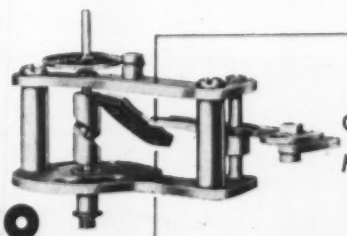

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Bridgeport 2, Connecticut

strument Div., Bendix Aviation Corp., Baltimore 4, Md.

R-759 HALF-WAVE RECTIFIER. 2-page bulletin describes maker's "IV2" miniature-type half-wave vacuum rectifier; lists general data; discusses installation and application.—Tube Dep't, Radio Corporation of America, Harrison, N. J.

R-760 DECIMAL SCALER. 6-page bulletin decribes maker's "Model 2000" for all nuclear measurements, medical work, industrial applications, physical and chemical research.—Berkeley Scientific Co., Richmond, Calif.

R-761 CYCLE CONTROLLER. 1-page bulletin describes and pictures maker's "Cyclo-Trol" for controlling mechanical time cycles.—Cyclotron Specialties Co., Moraga, Calif.

R-762 AUTOMATIC ELECTRIC FURNACE. 1-page bulletin describes with price list maker's laboratory furnace with complete automatic temperature control.—Western Gold and Platinum Works, 589 Bryant St., San Francisco, Calif.

R-763 RADIATION-DETECTION DENSITOMETER. 3-page Bulletin No. 270 gives complete description with price list of maker's photoelectric instrument for the exact measurement of density of x-ray film employed in personnel monitoring.—Photovolt Corp., 95 Madison Ave., New York 16, N. Y.

R-764 "ELECTRONIC PNEUMATIC MECHANICAL INSTRUMENTATION." 32-page Vol. 4, No. 2 issue of this house organ features articles titled "Adequate Instrumentation Aids Materially in Production of High Quality Textiles," "Progress Parade of Process Instrumentation" and eight other articles.—Brown Instrument Div., Wayne and Windrim Aves., Philadelphia 44, Pa.

R-765 GRAVIMETRIC WATER VAPOR PERMEABILITY CUPS. 2-page leaflet describes cups to determine water vapor permeability rates at any temperature or relative humidity.—Thwing Albert Instrument Co., Penn St. and Pulaski Ave., Philadelphia 44, Pa.

R-766 INTERRUPTER MACHINE. 2-page bulletin illustrates and describes maker's instrument for accurately timing and interrupting an electrical circuit.—Stromberg-Carlson, Rochester, N. Y.

R-767 "NOTES ON LINEAR VARIABLE DIFFERENTIAL TRANSFORMERS." 56-page booklet covers the subject thoroughly with editorial, picture, and charts.—Schaevitz Engineering, Camden 11, N. J.

R-768 PINCH-TYPE VALVES. 16-page Bulletin 450 describes with applications maker's line of slip-on type, flanged, diaphragm-motor type, valve positioner, etc. Also a page on rubber piping.—Flexible Valve Corp., Palisades Park, N. J.

R-769 SOIL TESTING. 2-page leaflet describes a new type combination soil testing outfit.—La Motte Chemical Products Co., Towson, Baltimore 4, Md.

R-770 PIPE LINE SHOCK ABSORBER. 2-page catalog insert pictures and describes four models of compact shock absorbers and excess pressure eliminators.—R-S Products Corp., 4530 Germantown Ave., Philadelphia 44, Pa.

R-771 BUTTERFLY VALVES. 12-page Catalog No. 18 features maker's 50-pound line of narrow face-to-face valves.—R-S Products Corp., Wayne Junction, Philadelphia 44, Pa.

R-772 ELECTRIC TACHOMETER. 4-page Bulletin No. 492 describes maker's electric tachometer and cutmeter.—Electric Tachometer Corp., 2218 Vine St., Philadelphia 3, Pa.

R-773 AUTOMATIC CIRCULAR DIVIDING MACHINE. 2-page Bulletin 182-49, describes a fully automatic machine for production ruling of precision circular scales.—Gaertner Scientific Corp., 1201 Wrightwood Ave., Chicago 14, Ill.

R-774 "TRACERLOG." 12-page No. 22 issue of this house organ features article titled "The Beta Gamma Samples for Radioassay."—Tracerlab, 130 High St., Boston 10, Mass.

R-775 POLARIZED D-C. RELAY. 6-page bulletin describes maker's "Micropositioner" voltage or differential circuit sensitive polarized relay for d-c. control circuits.—Barber-Colman, Rockford, Ill.

R-776 MICROHMMETER. 2-page bulletin pictures and describes "Model 151-S," a new instrument for low-resistance measurements.—J. W. Dice Co., Englewood, N. J.

R-777 ELECTRONIC METAL DETECTOR. 20-page bulletin describes and pictures operation and application of detector designed to safeguard non-metallic products.—Allis Chalmers, Milwaukee, Wis.

R-778 ELECTRIC HEATING UNITS. 52-page Catalog No. 50 describes four basic "Chromalon" units—strips, rings, tubulars and cartridges with wide variations in wattage, voltage and sheath material.—Edwin L. Wiegand Co., 7500 Thomas Blvd., Pittsburgh 8, Pa.

R-779 PAPER TESTING INSTRUMENTS. 4-page folder covers instruments for bursting pressures, bulking or thickness measurements, and obtaining basic weights.—E. J. Cady & Co., 134 N. LaSalle St., Chicago 2, Ill.

R-780 "COOK DIAPHLEN." 2-page Newsletter No. 10, Vol. 1, announces the "Hydtrol" medium-pressure switch.—Cook Electric Co., 2700 North Southport, Chicago 14, Ill.

R-781 NAMEPLATES. 2-color folder describes engraved laminated plastic nameplates for industry.—Industrial Nameplate Service, Box 5005, Houston 12, Texas.

R-782 "hp JOURNAL." 4-page Vol. 1, No. 2 issue of this house organ describes a new frequency standard and time interval generator.—Hewlett-Packard Co., 395 Page Mill Road, Palo Alto, Calif.

R-783 REFLECTOSCOPE. 4-page Bulletin 50-105 describes an ultrasonic instrument for locating defects in metals—Sperry Products, Danbury, Conn.

R-784 INDUSTRIAL THERMOMETERS. 16-page Bulletin E contains complete data on liquid-in-glass thermometers.—Precision Thermometer and Instrument Co., 1475 Brandywine St., Philadelphia 30, Pa.

R-785 WIRE MARKERS. 12-page catalog shows latest methods of marking wire, pipe, cable, conduit, etc.—Western Lithograph Co., 600 E. Second St., Los Angeles 54, Calif.

R-786 ANGLE CHECK VALVE. 2-page bulletin gives specifications for maker's angle check valves.—The Valv-Trol Co., 167 Hill St., Akron 8, O.

R-787 AUTOMATIC HIGH-PRESSURE INLET VALVE. 2-page bulletin gives specifications for maker's automatic high pressure inlet valves.—The Valv-Trol Co., 167 Hill St., Akron 8, O.

R-788 BALANCED TWO-WAY HYDRAULIC VALVES. 2-page bulletin gives specifications for maker's two-way hydraulic valves.—The Valv-Trol Co., 167 Hill St., Akron 8, O.

R-789 FLARING TOOL. 2-page Bulletin No. 378 describes a tool that flares, burnishes and does not score tubing.—Imperial Brass Mfg. Co., 1200 W. Harrison St., Chicago 7, Ill.

R-790 CARRIER-CIRCUIT EQUIPMENT. 8-page bulletin illustrates and describes maker's "Type 32" three-channel carrier with nine subchannels; discusses advantages, performance, characteristics.—Lenkurt Electric Co., San Carlos, Calif.

R-791 "CURRENT DATA ON HIGH VACUUM APPARATUS." 8-page, Vol. 1, No. 2 issue of this house organ features article titled "The Production of Low Pressures," discusses use of maker's high vacuum apparatus.—Vacuum Equipment Div., Distillation Products, Inc., Rochester 13, N. Y.

R-792 WATER HARDNESS TEST. 2-page bulletin describes maker's hardness titration test for water analysis; gives procedure, advantages (technical data in paper "Total Hardness in Water by Direct Colorimetric Titration").—W. H. and L. D. Betz, Gillingham & Worth Sts., Philadelphia 24, Pa.

R-793 ISOTOPE-RATIO MASS SPECTROMETER. 8-page Bulletin CEC-1803A describes maker's "Model 21-201 isotope-ratio mass spectrometer for measurment of stable rare isotopes; lists typical stable isotopes, their uses; discusses characteristics, performance, features, specifications.—Consolidated Engineering Corp., 620 No. Lake Ave., Pasadena 4, Calif.

R-794 LABORATORY EQUIPMENT. 12-page bulletin describes maker's laboratory ovens, analytical balances, electric furnaces; lists features, uses, specifications.—Boder Scientific Co., 719-721 Liberty Ave., Pittsburgh 22, Pa.

R-795 "CAREERS IN THE ELECTRICAL INDUSTRY." 32-page booklet pictures and discusses company's career possibilities, opportunity and training for electrical industry.—General Electric Co., Schenectady 5, N. Y.

R-796 PNEUMATIC GAGE. 14-page Catalog DTP-491 describes maker's dial type "Precisionaire" gage for dimensional checking; lists specifications, applications of various models.—The Sheffield Corp., Dayton 1, Ohio.

R-797 ZONE HEAT CONTROL. 8-page Bulletin F-3718 describes and illustrates use of maker's equipment in various applications of zone control for regulating heat supply.—Barber-Colman Co., Rockford, Ill.

R-798 INDUSTRIAL ELECTRICAL CONTROLS. 12-page bulletin describes maker's motor-operated valves, control motors and systems; lists applications, specifications.—Barber-Colman Co., Rockford, Ill.

R-799 THERMOSTATS. 2-page bulletin describes maker's "Type R" bimetal thermostats; discusses application, principle, operation, construction.—Stevens Mfg. Co., Inc., Mansfield, Ohio.

R-800 TIME DELAY RELAYS. 4-page bulletin describes maker's "Agastat" electropneumatic time relays; lists features, applications, specifications.—American Gas Accumulator Co., 1027 Newark Ave., Elizabeth 3, N. J.

R-801 "SELECTING MAGNETIC RELAYS FOR INDUSTRIAL CONTROLS." 12-page reprint of article by H. F. Littlejohn, Jr., discusses nine factors governing selection of industrial-type magnetic relays; effects on relay performance.—Ward Leonard Electric Co., Mount Vernon, N. Y.

R-802 ONE-HALF-OCTAVE FILTER. 2-page bulletin describes maker's "Model SA-2" one-half-octave filter; lists performance data, specifications.—Gertsch Products, Inc., 11846 Mississippi Ave., Los Angeles 25, Calif.

R-803 "S-L INSTRUMENT NOTES." 4-page No. 11 issue of this house organ contains articles titled "Electromagnetic Determination of Wire Stress," "Primary Standards of Linear Acceleration."—Statham Laboratories, Inc., 9328 Santa Monica Blvd., Beverly Hills, Calif.

R-804 TEMPERATURE TEST CHAMBER. 2-page Bulletin 5.1 describes maker's "Model TC-1" temperature test chamber; discusses features, capacity, specifications.—Statham Laboratories, Inc., 9328 Santa Monica Blvd., Beverly Hills, Calif.

R-805 CENTRALIZED CONTROL PANEL. 6-page Bulletin 509 describes maker's "Nullmatic" controls and use on graphic panel; discusses use, specifications.—Moore Products Co., H & Lycoming Sts., Philadelphia 24, Pa.

R-806 STRAIN-GAGE PICK-UP. 2-page Bulletin No. 1.3 describes maker's "Model G7" displacement or force transducer; lists features, specifications, selection table.—Statham Laboratories, 9328 Santa Monica Blvd., Beverly Hills, Calif.

R-807 MERCURY CLEANING. Demonstration samples of mercury contained in two vials held in corrugated pasteboard, illustrate "before and after" examples of mercury: (1) badly contaminated; (2) cleaned in maker's "Oxifier" and "Type F" filter.—Bethlehem Apparatus Co., 860 Front St., Hellertown, Pa.

R-808 CHEMICAL FEEDER. 4-page Catalog 62 describes maker's "Feed-rator" chemical feeder for liquids and gases; discusses operation, specifications; gives typical applications; lists chemicals handled.—Fischer & Porter Co., Hatboro, Pa.

R-809 SHOCK RECORDER. 4-page bulletin describes maker's "Impact-o-graph" shock recorder for determining cause, time and place of damage in merchandise handling; lists features, specifications.—Cleveland Impact Recorder, Inc., Union Commerce Bldg., Cleveland 14, Ohio.

R-810 "THE OHMITE NEWS." 2-page October issue of this house organ contains articles on maker's resistors and their varied uses.—Ohmite Mfg. Co., 4835-41 Flournoy St., Chicago 44, Ill.

R-811 "SPECTROGRAPHER'S NEWSLETTER." 4-page Vol. III, No. 2 issue of this house organ features articles titled "A New Solution Excitation Attachment," "Spectro-chemical Analysis of Copper Alloys."—Applied Research Labs., 4336 San Fernando Rd., Glendale 4, Calif.

R-812 TACHOMETERS. 8-page bulletin de-

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scribes maker's line of "Westach" engine, industrial, portable tachometers, wind speed and direction equipment, etc.; gives specifications, features, list of users.—Westberg Mfg. Co., 612 N. Michigan Ave., Chicago 11, Ill.

R-813 "MODERN PRECISION." 8-page Vol. 9, No. 2 issue of this house organ features articles on uses of maker's recorders and controllers in metals, process industries, ceramics, power, reasearch, teaching and testing.—Leeds & Northrup Co., 4902 Stenton Ave., Philadelphia 44, Pa.

R-814 SPRING TESTER. 4-page Bulletin No. 302 describes maker's small spring tester; lists features, operation, uses, specifications.—Testing Equipment Dep't, Baldwin Locomotive Works, Philadelphia 42, Pa.

R-815 MAGNIFYING MICROMETER. 4-page Bulletin 49-M describes maker's magnifying micrometer for measuring thickness of plating, paint, enamel; discusses features, uses.—Krouse Testing Machine Co., 573 E. Eleventh Ave., Columbus 3, Ohio.

R-816 RECORDING OSCILLOGRAPHS. 16-page Bulletin CEC-1500A describes maker's multichannel recording oscillographs; discusses applications, operations, features; contains sample records, detailed assembly drawings.—Consolidated Engineering Corp., 620 No. Lake Ave., Pasadena 4, Calif.

R-817 FIREWALL CONNECTORS. 8-page bulletin describes maker's "Type AN" aircraft firewall connectors; gives features, specifications.—Cannon Electric Development Co., 3209 Humboldt St., Los Angeles 31, Calif.

R-818 MICA CAPACITORS. 12-page 1949-50 catalog describes maker's "El Menco" line of mica capacitors; lists specifications, ordering instructions.—Arco Electronics, Inc., 135 Liberty St., New York, N. Y.

R-819 WATTHOUR METER. 12-page Catalog No. 4425 describes maker's "Type S-3" watthour meter; discusses construction, assembly, applications.—Roller-Smith, Bethlehem, Pa.

R-820 INSTRUMENT VALVES. 4-page Bulletin No. 491 describes maker's instrument valves

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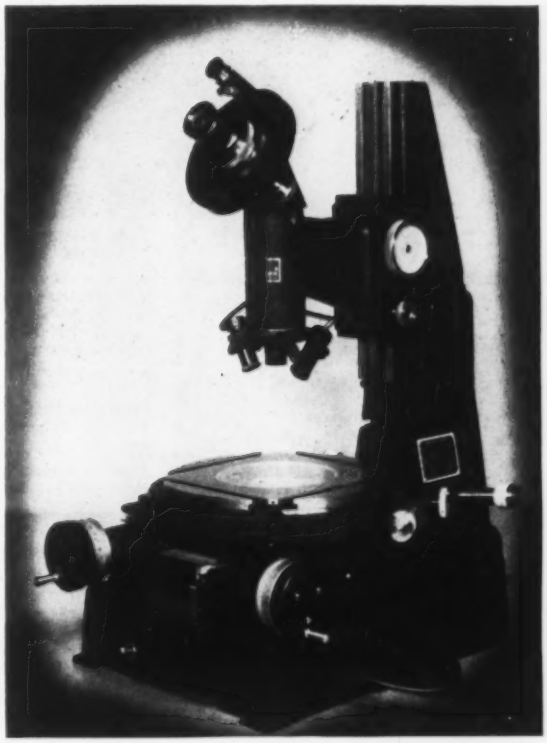

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for meter, gage, instrument lines; lists dimensions, operating data, weights, prices.—Edward Valves, Inc., East Chicago, Ind.

R-821 MACHINE COMPUTATION. 12-page brochure describes maker's engineering-computing service, "Telecomputing"; gives history, service procedure and applications, typical problem.—Telecomputing Corp., 2901 Hollywood Way, Burbank, Calif.

R-822 OIL REGULATOR. 2-page bulletin describes maker's "L-25" oil regulator for gravity-type feed oil-fired burners; lists features, dimensions.—Superior Controls Co., Inc., Drawer "X", Los Angeles 41, Calif.

R-823 STEAM PRESSURE REGULATORS. 4-page bulletin describes maker's "Type A-21" steam pressure regulator for gas fired boilers, and "Type A-61" temperature thermostat; lists features, dimensions, capacity.—Superior Controls Co., Inc., 1835 S. Bonnie Brae, Los Angeles 6, Calif.

R-824 "The C-D CAPACITOR." 16-page Vol. 14, No. 11 issue of this house organ features article titled "A Serviceman's R-C-L Bridge"; contains monthly "The Radio Trading Post" section.—Cornell-Dubilier Electric Corp., Hamilton Blvd., South Plainfield, N. J.

R-825 CATHODE-RAY OSCILLOGRAPHS. 2-page bulletin describes maker's "Type 304" and "Type 304-H" successor to "Type 208" cathode-ray oscillograph; lists features, dimensions, specifications.—Allen B. Du Mont Labs., Inc., 1000 Main Ave., Clifton, N. J.

R-826 INDUSTRIAL CLAMP. 4-page Bulletin 310 pictures and describes maker's "Neg'ator" industrial clamp; discusses principle of operation, characteristics, applications.—Neg'ator Div., Hunter Spring Co., Lansdale, Pa.

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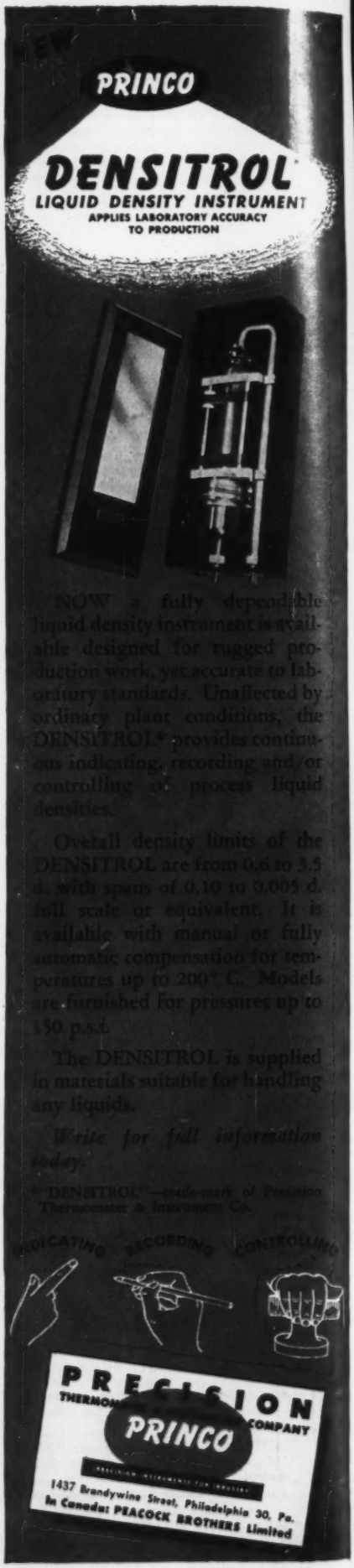
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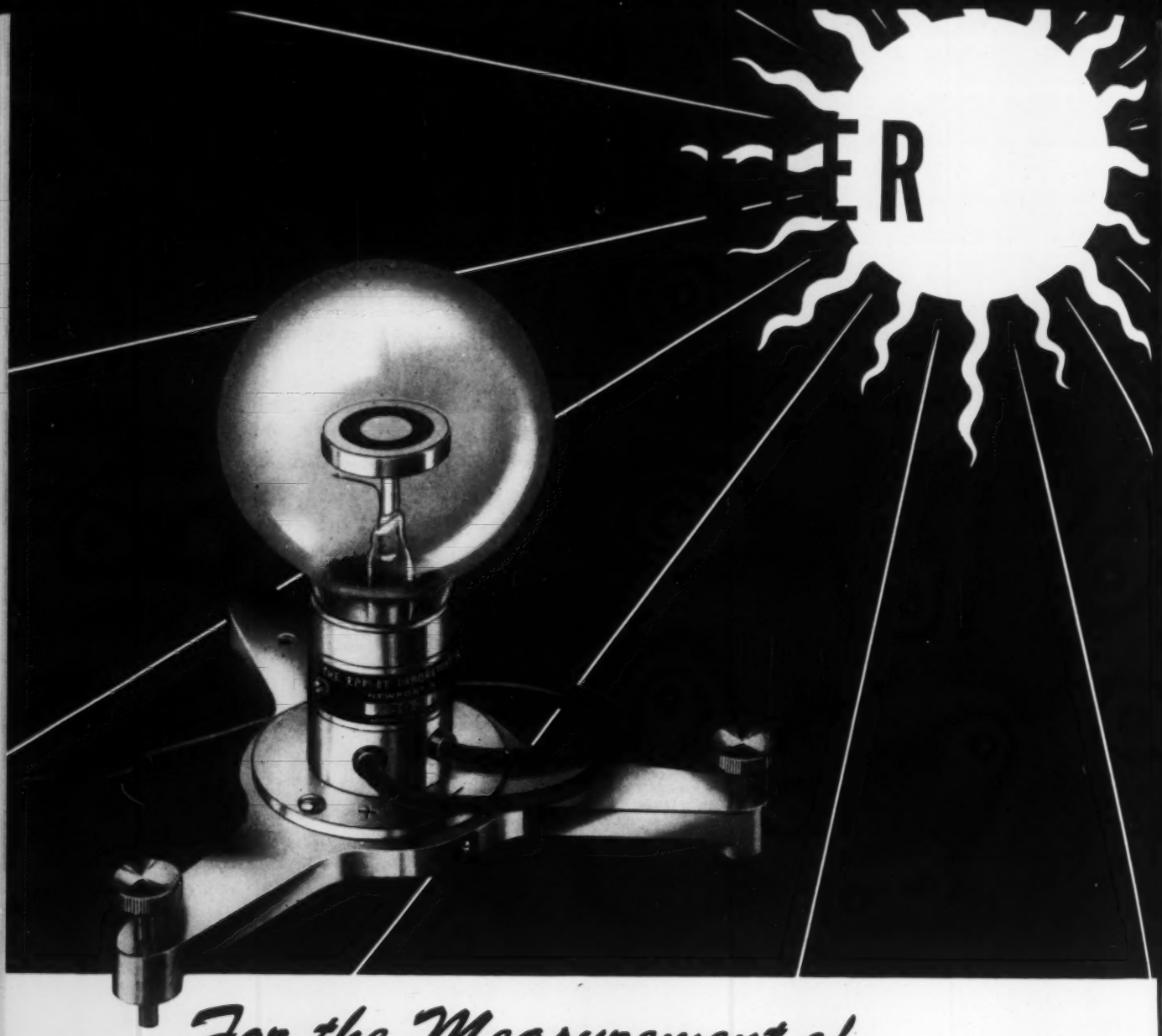

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CLIMAX ENGINEERING COMPANY

Controls Division — **Tulsa 1, Oklahoma**

DUO-PHASE; DUO-GRAVITY CONTINUOUS DRAINERS

Climax Type 90 Drainers are designed for continuous draining of water, condensate or oils from systems. They are especially adaptable for use as steam traps on fractionators, reboilers, kettles, and other temperature equipment. Within volume limitations, the Type 90 Drainer may serve as a level controller on drips, tanks, and other pressure vessels.

Working pressures up to 600 lbs. Bodies—Cast iron and cast steel. Removable orifices 1/16" to 3/4" available.

Climax Type 91 Drainers are identical in construction details to Type 90 Drainers, except the float arm is weighted to sink in liquids of gravities higher than 40° API (.825 Sp. Gr.), and float on water. They are recommended for service on water knock-out trays of distillation columns, drainers for reflux accumulators and other services where continuous draining of heavier fluids is necessary.

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Climax Type 140 and Climax Type 141 Drainers are similar in application services to Climax Type 90 and Climax 91 Drainers except that they have more float power available, due to head construction, permitting use for higher working pressures. Climax Type 140 Drainer body placed in an inverted position will eliminate air, gas or vapor from pressure systems. Climax Type 140 and Climax Type 141 Drainers have head flange construction in accordance with ASA Code rating.

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Climax Type 146 Drainers are designed for handling larger volumes, within pressure limitations, than the Type 90 or Type 140 Drainers. These units can be either normally opened or normally closed, body being reversible. New construction features eliminate the friction "bind" of valve stem and permit body rotation to any desired position.

Working pressure up to 600 lbs. Bodies—Cast iron and cast steel.

When ordering Climax Drainers, please specify:

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For other types of Climax Drainers or Vent Traps, and for higher working pressures—
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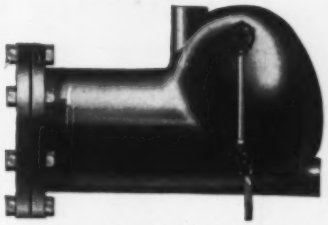
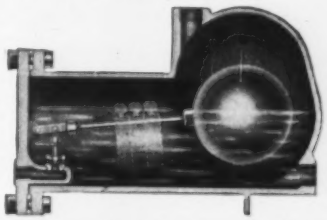
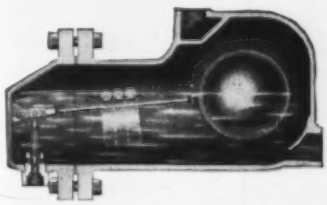


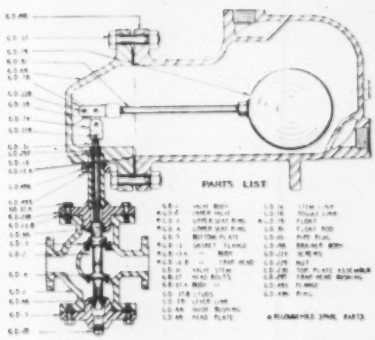
Climax Type 90 Duo-Phase Continuous Drainer



Climax Type 91 Duo-Gravity Continuous Drainer



Climax Type 141 Duo-Gravity Continuous Drainer



Climax Type 146 Duo-Phase Continuous Drainer

TYPE 1400—PRESSURE CONTROLLER

(non-recording)

Pressure Range: Vacuum Control to 10,000 pounds

Climax Type 1400 Pressure Controller is designed to handle both positive and negative pressures, from high vacuum to any amount of pressure desired. Bourdon Tube actuated, Type 1400 is adaptable to operations requiring highest sensitivity, or where throttling ranges are necessary to dampen sensitivity. It overcomes cyclic or hunting action where conditions make "lined-out" pressure control difficult. Adaptable to vacuum relief control; vacuum control; fluid pressure control; boiler steam; pressure control; off-and-on control; and snap action where the two limits may each be set at any desired pressure up to 25% of Bourdon Tube rating.

Range: Vacuum to 10,000 lbs. working pressure. Throttling range adjustable 0-200 per cent. Bourdon Tube Ratings available—30 lbs., 60 lbs., 100 lbs., 300 lbs., 750 lbs., 1000 lbs., 1500 lbs., 2000 lbs., 3000 lbs., 5000 lbs., and 10,000 lbs.

For more detailed information on Pressure Controllers
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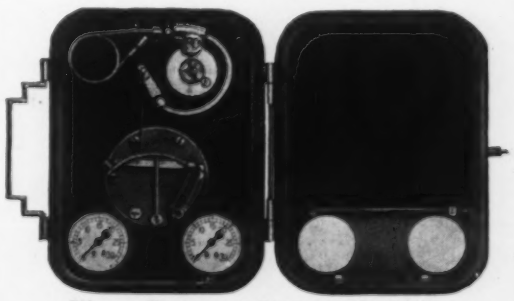
Continued on Next Page

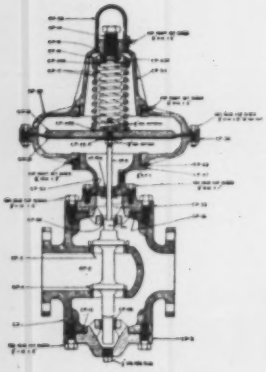


Climax Type 1400 Pressure Controller

CLIMAX ENGINEERING COMPANY

Controls Division — **Tulsa 1, Oklahoma**

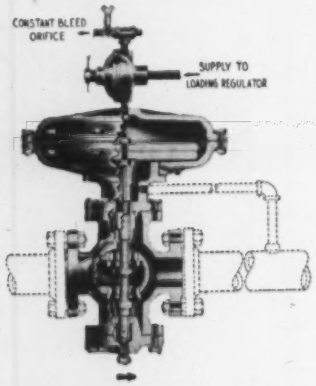
SELF OPERATED REGULATORS



Climax Type 28 Back Pressure Regulator

Climax Type 28 Regulator is designed as a compact unit using long springs for sensitivity where flowing medium does not radically fluctuate. Valve bodies are reversible making it possible to change in field without extra parts from relief to reducing regulator.

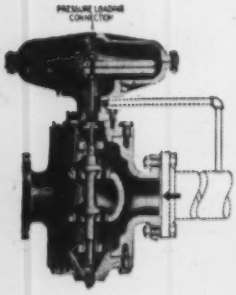
Spring Loaded, Pressure Operated, Diaphragm Actuated. Sizes: ½″ to 2″ Screwed Globe. 1″ to 8″ Flanged Globe (ASA). Maximum Controlled Pressure: 1 to 40 lbs. Maximum Temperature: 150° F.



Climax Type 77 Pressure Reducing Regulator

Climax Type 77 Regulator is pressure balanced with Type 216 Loading Regulator or Type 2019 Low Pressure Loading Regulator and recommended for engine fuel pressure control service or other services requiring the highest degree of sensitivity. Bodies and trim are fully reversible.

Pilot Loaded, Pressure Balanced, Diaphragm Actuated. Sizes: ½″ to 2″ Screwed Globe. 1″ to 10″ Flanged Globe (ASA). Bodies: Semi-steel and cast steel, Maximum Inlet Pressure: 10 lbs. Controlled Pressure: 2 to 25 lbs. Maximum Temperature 150° F.

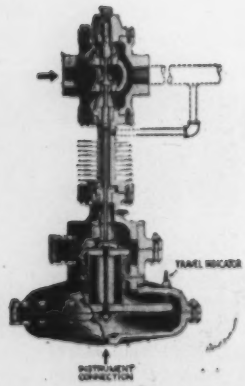


Climax Type 96-D Simplex Diaphragm Regulator

Climax Type 96 Regulators are designed for use with pressure controllers for reducing or back pressure service. Recommended for exacting temperature control applications.

Climax Type 97 Regulators are gas or air loaded. Since diaphragm areas are fixed, changes in controlled pressure may be effected by a proportionate change in loading pressure.

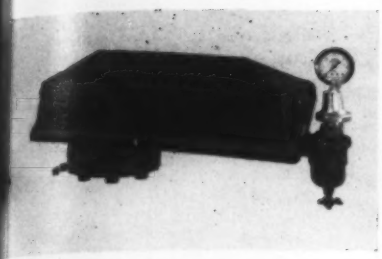
Pressure Balanced, Diaphragm Actuated. Sizes: ½″ to 2″ Screwed Globe (Types 96 and 97); 1″ to 10″ (Type 96), 1″ to 6″ (Type 97) Flanged Globe (ASA), Bodies: Semi-steel and cast steel. Maximum Inlet Pressure: 300 lbs. Controlled Pressures: Type 96—4″ water to 25 lbs.; Type 97—4″ water to 100 lbs. Loading Pressure: Type 97—2 to 25 lbs. Maximum Temperature: 150° F. or 450° F. with Fins.



Climax Type 97-RF Duplex Diaphragm Regulator with Fin Section

When ordering please specify: Type Number, Body size, material and style, Trim Material . . . Double Port, quick opening valves are standard. Inlet and outlet pressures thru valve body and controlled pressure range, Volume, gravity and temperature of flowing medium.

For other types of self operated Back Pressure Regulators, Vacuum Regulators, Pressure Reducing Regulators, and Differential Pressure Relief Valves—ASK FOR CLIMAX CATALOG SECTION NO. 107.



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Republic pneumatic transmitters are devices for converting process variables, such as flow, liquid level, pressure or liquid density, into air pressures which vary proportionally with the process variables.

These air pressures can be used as the measuring impulse for the actuation of an automatic controller or a direct reading recorder.

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General Controls
Grove Regulator
Hagan Corp.
Hammel-Dahl Co.
Instruments Corp.
Kiely & Mueller
Klipfel Mfg.
Leupold & Stevens
Lumenite Co.
Magnetrol Inc.
Mason-Neilan Regulator
McAlear Mfg.
Mecroid Corp.
Mercon Regulator Co.
Moore Products
Northern Equipment
Positel Mfg. Co.
Powers Regulator Co.
Republic Flow Meters
Ruggles-Klingemann
Schade Valve Mfg. Co.
Shallcross Controls
Simplex Valve & Meter
Spence Eng. Co., Inc.
Swartwout Co.
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Water Level Controls Co.

CONTROLLERS, AUTOMatic, Flow
Ace Instrument
American Meter Co.
Area Regulators, Inc.
Askania Regulator
Automatic Temp. Control
Bailey Meter Co.
Barber-Colman Co.
Beck Co.
Bristol Co.
Brooke Engineering
Brooks Rotameter
Brown Inst. Div.
Builders-Providence
Cash Co.
Clark Cooper Co.

(Continued)

Cook Electric
Cutler-Hammer, Inc.
Davis Regulator
Denver Fire Clay Co.
Electrimatic Corp.
Fischer & Porter
Fisher Governor
Ford Regulator Valve
Foster Engg. Co.
Foxboro Co.
Fulton Sylphon Co.
General Controls
General Regulator Corp.
G. M. Mfg. Co.
Grove Regulator
Gump Co., B.F.
Hagan Corp.
Hammel-Dahl Co.
Hays Corp.
Henszey Co.
Kahl Sci. Inst. Co
Klipfel Mfg. Co.
Leeds & Northrup Co.
Leslie Co.
Leupold & Stevens
Lumenite Co.
Magnetrol, Inc.
Mallory & Co.
Mason-Neilan Regulator
Mercon Regulator
Milton Roy Pumps
Moore Products
North American Mfg.
Northern Equipment
Penn Ind. Inst.
Permutit Co.
Process Controls, Inc.
Proportioneers, Inc.
Republic Flow Meters
Robinette Co., W. C.
R-S Prod. Corp.
Schutte & Koerting
Shallcross Controls
Simplex Valve & Meter
Sparling, R.W.
Spence Eng. Co., Inc.
Tagliabue Corp., C.J.
Taylor Inst. Cos.
Trimount Inst. Co.
Waterman Engineering
Wheelco Instruments
Wilgus Mfg. Co.

CONTROLLERS, AUTOMATIC, Flow Proportioning
Ace Instrument
American Meter Co.
Area Regulators, Inc.
Askania Regulator Co.
Autocall Co.
Automatic Temp. Control
Bailey Meter Co.
Barber-Colman Co.
Beck Co.
Bristol Co.
Brooke Eng. Co.
Brooks Rotameter
Brown Inst. Div.
Builders-Providence
Cash Co.
Connelly, Inc.
Cutler-Hammer, Inc.
Electronic Prod. Co.
Fischer & Porter
Fisher Governor
Foxboro Co.
Fulton Sylphon Co.
General Controls
General Regulator Corp.
Hagan Corp.
Hammel-Dahl Co.
Hays Corp.
Henszey Co.
Klipfel Mfg. Co.
Lammert & Mann Co.
Leeds & Northrup Co.
Leslie Co.
Mason-Neilan Regulator
McAlear Mfg. Div.
Mercon Regulator Co.
Milton Roy Co.
North American Mfg.
Penn Ind. Inst. Co.
Proportioneers, Inc.
Republic Flow Meters Co.
Reynolds Gas Regulator
Robinette Co.
R-S Prod. Corp.
Sampsel Time Control
Schutte & Koerting
Shallcross Controls
Simplex Valve & Meter
Sparling, R.W.
Spence Engr. Co., Inc.
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Wallace & Tiernan
Wheelco Inst. Co.

CONTROLLERS, AUTOMATIC, Fluid Proportioning (See Controllers Automatic, Flow Proportioning)

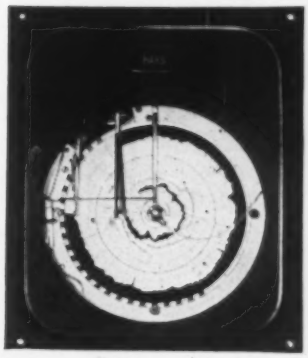
CONTROLLERS, AUTOMATIC, Frequency (See Regulators)

CONTROLLERS, AUTOMATIC, Furnace
Abrams Instrument
Ace Instrument Co.
A-Jacks Automatic
Area Regulators, Inc.
Askania Regulator Co.
Assembly Products
Automatic Elec. Mfg. Co.
Automatic Temp. Control
Bailey Meter Co.
Barber-Colman Co.
Beck Co.
Bristol Co.
Brooke Eng. Co.
Brown Inst. Div.
Burling Instrument Co.
Burrel Tech. Supply
Cash Co.

(Continued)

Experienced engineers call it "unfailing"

...HAYS CO_2 RECORDER



A thoroughly reliable indicator of CO_2 in the flues, the Hays CO_2 Recorder is truly an unfailing meter of combustion efficiency. It operates entirely by water on the true Orsat principle of volumetric measurement and chemical absorption. No moving parts—literally nothing to wear out. Automatic, permanently mounted. Send for Bulletin 47-550.

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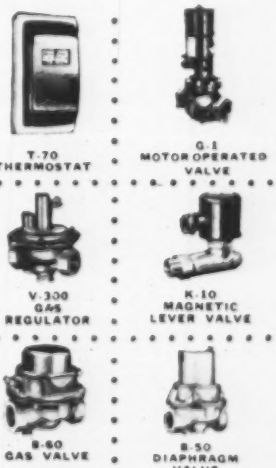
- GAS REGULATORS
- LOW WATER CONTROLS
- STRAINERS, RELAYS
- TRANSFORMERS, SWITCHES
- PORTABLE EQUIPMENT CONTROLS
- MACHINE TOOL CONTROLS



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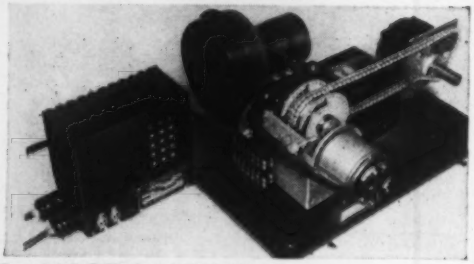

ADD A MICROMETER

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2%-3% Regulation

Micrometer Set to
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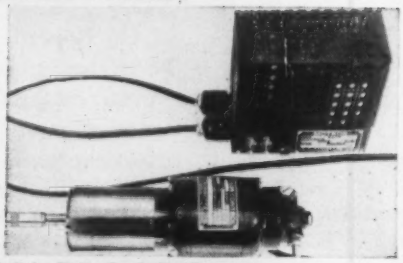
to 1/12 HP



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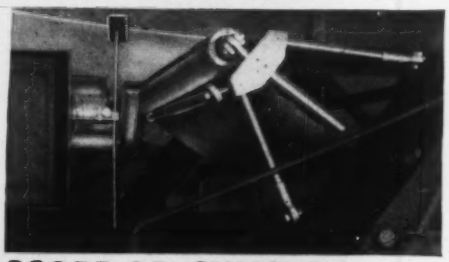

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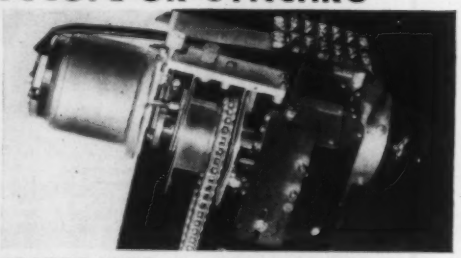
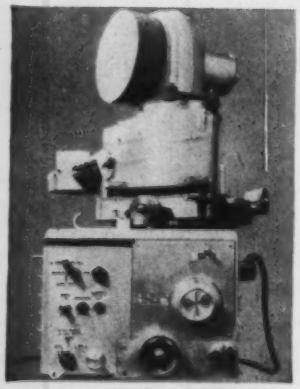
Remote Speed Control to .05% or exact Synchronizing to any A.C. standard frequency. Torque limiting or balancing optional



ADD SPECIAL ENGINEERING + EQUIPMENT



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Partlow Corp.
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Perfex Corp.
Pyrometer Inst. Co.
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Robinette Co., W. C.
R-S Prod. Corp.
Ruggles-Klingermann
Samsel Time Control
Shallcross Controls
Spence Engineering Co.
Taco West Corp.
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Thwing-Albert Inst. Co.
United Elec. Controls
Westinghouse Elec.
Wheelco Inst. Co.
White Mfg. Co.
White-Rodgers Electric
Wilgus Mfg. Co.

CONTROLLERS, AUTOMATIC, Gas Density
Askania Regulator Corp.
Bailey Meter Co.
General Controls
General Power Plant
Hagan Corp.
Leeds & Northrup Co.
Moore Products
Refinery Supply Co.
Shallcross Controls

CONTROLLERS, AUTOMATIC, Gas Mixing (See Controllers, Automatic, Flow Proportioning)

CONTROLLERS, AUTOMATIC, Granular Material Level
Askania Regulator Co.
Bin-Dicator Co.
Builders-Providence
Electronic Prod. Co.
Fuller Co.
General Controls
Gumm Co., R. F.
Merrick Scale
Mosher Electronic
Photoswitch, Inc.
Robinette Co., W. C.
Shallcross Controls
Wheelco Instruments

CONTROLLERS, AUTOMATIC, Granular Material Weight
Builders-Providence
General Controls
Merrick Scale
Omega Machine
Photoswitch, Inc.

CONTROLLERS, AUTOMATIC, Gravity
Area Regulators, Inc.
Askania Regulator Co.
Bailey Meter Co.
Bristol Co.
Cash Co.
Ess Instrument
Foxboro Co.
Hagan Corp.
Hays Corp.
Leeds & Northrup Co.
Manning, Maxwell & Moore
Mason-Neilan Regulator
Mine & Smelter Supply
Moore Products
Precision Thermometer
Republic Flow Meters
Shallcross Controls
Tagliabue Corp., C. J.
Taylor Inst. Cos.

CONTROLLERS, AUTOMATIC, Humidity
American Inst. Co.
American Moistening Co.
Area Regulators, Inc.
Atlas Valve Co.
Barber-Colman Co.
Barbender Corp.
Bristol Co.
Brown Inst. Div.
Cramer & Co., Inc.
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Electronic Engineers
Electronic Prod. Co.
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Norcross Lab
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Powers Regul
Sampsel Tim
Sarco Co., In
Scientific Ins
Serdex, Inc.
Tagliabue Cor
Taylor Inst.
Tenney Engin
Thwing-Albert
Trerice Co., H
United Elec.
Valverde Labs
Varo Mfg.
Vaughn-G.E.
Weksler Therm
Wheelco Insts.
White-Rodgers
Zeiss, Inc., Ca

CONTROLLERS, AUTOMATIC, Humidity and Temperature (See Controllers, Automatic, Humidity and Temperature; Controllers, Automatic, Temperature)

CONTROLLERS, AUTOMATIC, Lighting
Abrams Instrument
Askania Regulator
Automatic Elec. Mfg.
Betts & Betts
Cutler-Hammer, Inc.
Electronic Controls
Fisher-Pierce Co.
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General Elec. Co.
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Superior Electric
Tork Clock
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Weston Elec. Inst. Corp.

CONTROLLERS, AUTOMATIC, Liquid Level
Allen-Bradley Co.
American Meter Co.
Area Regulators, Inc.
Askania Regulator Co.
Atlas Valve Co.
Autocall Co.
Automatic Control Co.
Automatic Temp Control
Bailey Meter Co.
Barber-Colman
Bastian-Blessing Co.
Belfield Div.
Bin-Dicator Co.
Boylston Co.
Bristol Co.
Brooke Engineering
Brown Inst. Div.
Builders Providence
B. W. Controller
Cash Co.
Clapp Instrument
Clark Cooper Co.
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Control Corp.
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Defender Automatic Reg.
Elec. Indicator Co.
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Farris Engineering
Fischer & Porter
Fisher Governor Co.
Fisher-Pierce Co.
Ford Regulator Valve
Foster Engg. Co.
Foxboro Co.
Frick Co.
Fuller Co.
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General Electric Co.
General Regulator Corp.
Grove Regulator
Guardian Elec. Mfg. Co.
Hagan Corp.
Hammel-Dahl Co.
Hays Corp.
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Mercoid Corp.
Mercon Regulator Co.
Minneapolis-Honeywell
Moore Products Co.
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Natural Gas Equipment
Norcross Corp.
Northern Equip. Co.
Panellet, Inc.
Paragon Electric Co.
Penn Electric Switch
Penn Ind. Inst. Corp.
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R-S Products

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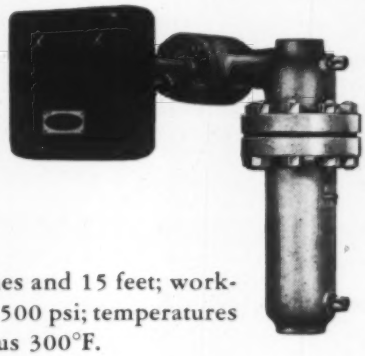
MASONEILAN EQUIPMENT IMPROVES PROCESS CONTROL

12000 SERIES DISPLACEMENT TYPE LIQUID LEVEL CONTROLLERS

For all usual liquid level control, measurement and signaling applications, including interface service.



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Between 14 inches and 15 feet; working pressure to 1500 psi; temperatures to 750°F or minus 300°F.

Level Instrument Mechanisms

Two position Differential-Gap, Proportional or Proportional-Reset Control; Pneumatic Transmission; Pneumatic Signal Switch; Duplex Control; Control plus Pneumatic Transmission or Pneumatic Signal Switch.

NO. 2700 PRESSURE CONTROLLER

These controllers are designed for many industrial applications requiring accurate control where more expensive instruments are not warranted. Ranges between 30″ Hg. Vac. and 1000 psi. Standard proportional band 3 to 50%.

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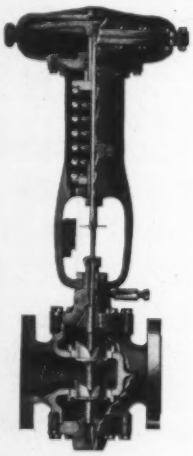
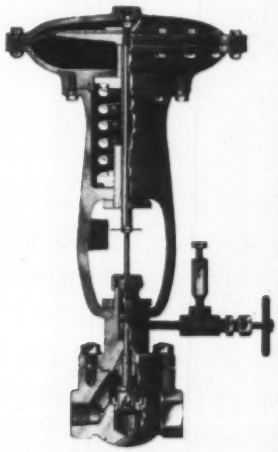


No. 38
Percentage V-Port Control Valve



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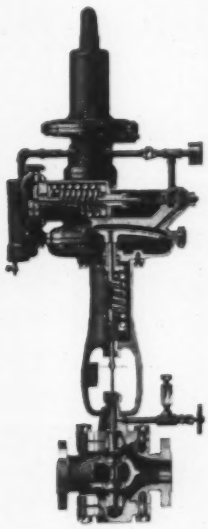
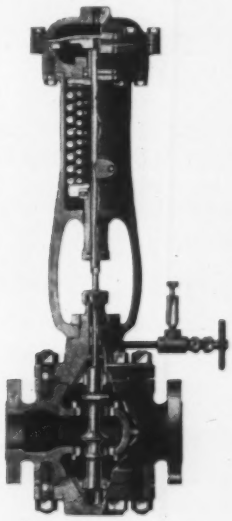
No matter what the application — temperature, pressure, level and flow, there is a Masoneilan control valve designed to meet the requirements. They are available in a wide range of types and sizes from 1/16″ orifice and up.

REDUCING PRESSURE REGULATORS



No. 27



No. 35

These Regulators have a wide variety of controlled pressure ranges and are accurate within each range. Standard sizes from 1/2″ to 8″.

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AUTOMATIC TEMPERATURE CONTROL COMPANY, INC.
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LIQUID LEVEL CONTROLS
for practically
ANY LIQUID
at any TEMPERATURE
at any PRESSURE

TANK FLOAT SWITCHES
- Top Mounting
- Side Mounting
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DIFFERENTIAL PRESSURE SWITCHES
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Taylor Inst. Cos.
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Trimount Inst. Co.
Uehling Instrument Co.
United Electric Controls
Warrick Co.
Water Level Controls Co.
Watts Regulator Co.
Wheelco Inst. Co.

CONTROLLERS, AUTOMATIC, Load (See Regulators)

CONTROLLERS, AUTOMATIC, Moisture (See Controllers, Automatic, Humidity)

CONTROLLERS, AUTOMATIC, PH
Askania Regulator
Bailey Meter Co.
Bristol Co.
Brown Inst. Div.
Foxboro Co.
General Controls
Leeds & Northrup
Macbeth Corp.
Milton Roy Co.
National Tech. Labs.
Thwing-Albert Inst. Co.

CONTROLLERS, AUTOMATIC, Phase (See Regulators)

CONTROLLERS, AUTOMATIC, Power Factor (See Regulators)

CONTROLLERS, AUTOMATIC, Pressure & Vacuum
Ace Instrument Co.
Acme Regulator Co.
Allen-Bradley Co.
American Meter Co.
Arca Regulators, Inc.
Askania Regulator Co.
Atlas Valve Co.
Autocall Co.
Automatic Control Co.
Automatic Temp. Control
Bailey Meter Co.
Barber-Colman
Bastian-Blessing Co.
Beck Co.
Belfield Div.
Bockel & Co.
Boylston Co.
Bristol Co.
Brooke Eng. Co.
Brown Inst. Div.
Builders-Providence
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Dennison Eng. Co.
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Dickson Co.
Distillation Products
Douglass Automatic
Eclipse Fuel Engg.
Electronic Engineers
Electronic Prod Co.
Emerson Apparatus Co.
Emmett Machine
Farris Engineering
Fisher Governor Co.
Ford Reg. Valve Co.
Foster Engg. Co.
Foxboro Co.
Fredericks Co., George
Fuel Watchman
Fulton Sylphon Div.
Furnas Electric Co.
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General Electric Co.
General Power Plant
General Regulator Corp.
Gotham Inst. Co.
Grove Regulator
Hagan Corp.
Hammel-Dahl Co.
Hays Corp.
H & H Thermostats
Hoke, Inc.
Hydraulic Controls, Inc.
Ideal Lab. Tool
Instrument Rep. & Mfg.
Instruments Corp.
Keckley Mfg. Co.
Kiely & Mueller
Klipfel Mfg. Co.
Lammert & Mann Co.
Leeds & Northrup Co.
Leslie Co.
Manning, Maxwell, Moore
Marsh Corp.
Mason-Neilan Regulator
McAlear Mfg.
Meletron Corp.
Mercoid Corp.
Mercon Regulator Co.
Minneapolis-Honeywell
Moore Products
Mu-Switch Corp.
Nason Co.
National Time & Signal
Natural Gas Equip. Inc.
Northern Equip. Co.
Panellet, Inc.
Penn Ind. Inst. Corp.
Perfex Corp.
Powers Regulator Co.
Precision Regulator Co.
Precision Scientific
Precision Therm.
Process & Instruments
Republic Flow Meters
Reynolds Gas Regulator
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Robinette Co., W. C.
Ruggles Klingemann
Sampsel Time Control
Schade Valve Mfg. Co.
Schwien Eng. Co.
Scientific Inst. Co.
Seely Instrument Co.
Selas Co.
Shallcross Controls
Sinclair-Collins Valve
Skaneateles Mfg.
Spence Engineering Co.
Squires Co.
Sterling Eng. Co.
Swartwout Co.
Tagliabue Corp., C. J.
Taller & Cooper
Taylor Inst. Cos.
Trerice Co., H. O.
Trimount Inst. Co.
United Elec. Controls
Uehling Instrument Co.
Vapor Recovery Systems
Vaughn-G. E. Witt Co.
Viking Instruments
Wallace & Tiernan
Ward Leonard Elec. Co.
Water Level Controls Co.
Wheelco Inst. Co.
White-Rodgers Electric
Yellow Springs Inst.

CONTROLLERS, AUTOMATIC, Pyrometric
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Ashcroft Auto. Cont.
Askania Regulator Co.
Assembly Products
Automatic Temp. Control
Bailey Meter Co.
Bristol Co.
Brown Inst. Div.
Burling Inst. Co.
Dickson Co.
Electronic Prod. Co.
Engelhard, Chas.
Ferner Co.
Foxboro Co.
Fuel Watchman
General Elec. Co.
G-M Labs
Illinois Testing Labs.
Klipfel Mfg.
Leeds & Northrup Co.
Lewis-Engg. Co.
Manning, Maxwell, Moore
Mason-Neilan Regulator
Partlow Corp.
Perfex Corp.
Pyrometer Instrument Co.
Pyrometer Service Co.
Revere Corp.
Robinette Co., W. C.
Taco West Corp.
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Thwing-Albert Instrument
Trerice Co., H. O.
Uehling Instrument Co.
Wheelco Inst. Co.
Wilgus Mfg. Co.

CONTROLLERS, AUTOMATIC, Radio Remote
Automatic Elec. Chicago
Bristol Co.
El-Tronics, Inc.
Flader Inc., Fredric
Guardian Elec. Mfg. Co.
Hastings Inst. Co.
Jacobs Instruments
McFarlin Co.
Metron Instrument
Polarad Electronics
Radio Receptor Co.
RCA Div.
Schwien Engg. Co.
Servo Corp. of America
Sorensen & Co.
Summers Gyroscope
Wallace & Tiernan
Yardeny Engineering Co.

CONTROLLERS, AUTOMATIC, Rate-Volume (See Controllers, Automatic, Flow)

CONTROLLERS, AUTOMATIC, Refrigeration
Allen-Bradley Co.
Automatic Elec. Mfg.
Automatic Temp. Control
Brown Inst. Co.
Burling Instrument Co.
Cash Co.
Cutler-Hammer, Inc.
Dickson Co.
Electrimatic Corp.
Flow Controls, Inc.
Foxboro Co.
Frick Co.
Friez Instrument
Fulton Sylphon Co.
General Controls Co.
General Elec. Co.
Hammel-Dahl Co.
Lumenite Elec. Co.
Magnetrol, Inc.
Manning, Maxwell, Moore
Mason-Neilan Regulator
McAlear Mfg. Co.
Mercoid Corp.
Minneapolis-Honeywell
Penn Electric Switch
Perfex Corp.
Phila. Thermometer Co.
Ranco, Inc.
Sarco Co., Inc.
Schade Valve Mfg. Co.
Skaneateles Mfg.
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Thermo Instruments
United Elec. Controls
White-Rodgers Electric

CONTROLLERS, AUTOMATIC, RKVA (See Regulators)

CONTROLLERS, AUTOMATIC, Specific Gravity (See Controllers, Automatic, Gravity)

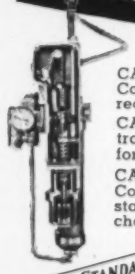
CONTROLLERS, AUTOMATIC, Speed (See Tachometric below)

Correct
FUEL-AIR RATIO
FUEL FEED OVER-FIRE DRAFT

Get all three and have these results:
1. More steam from your present boiler
2. Less fuel—coal—oil—gas required
3. Savings in maintenance

WHETHER YOU HAVE ONE OR A BATTERY OF BOILERS . . . INSTALL

CASH STANDARD
AUTOMATIC COMBUSTION CONTROL SYSTEMS



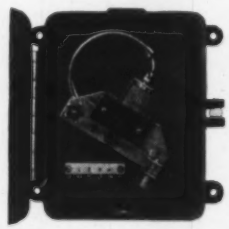
CASH STANDARD Fuel Feed Controller . . . automatically regulates fuel feed
CASH STANDARD Air Flow Controller . . . meters the air needed for combustion
CASH STANDARD Furnace Draft Controller . . . maintains a constant draft in the combustion chamber

Bulletin No. 300 shows applications . . . tells how the System works in your favor . . . Send for it.

CASH STANDARD CONTROLS . VALVES

A. W. CASH COMPANY
DECATUR, ILLINOIS

SPECIFY . . .
ATCOTRAN
FOR
ELECTRICALLY TRANSMITTED PRESSURE MEASUREMENTS



The ATCOTRAN System, operating from Bourdon tube, bellows or diaphragm, transmits pressure intelligences *with accuracy of ¼ of 1% of reading* to specially developed types of indicators and recorders.

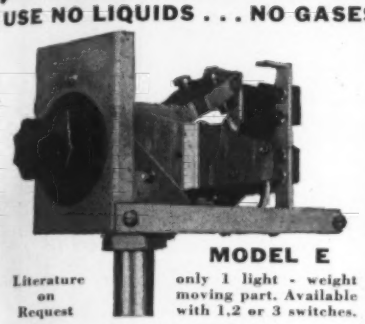
Systems available for simple installation, in ranges 0—100,000 psi. Expensive piping and high-pressure safety installations eliminated.

Request BULLETIN R-20

atc Industrial Controls
AUTOMATIC TEMPERATURE CONTROL COMPANY, INC.
[illegible] PHILADELPHIA PENNA

BURLING
TEMPERATURE LIMIT SWITCHES

USE NO LIQUIDS . . . NO GASES



MODEL E

Literature on Request

only 1 light - weight moving part. Available with 1,2 or 3 switches.

As a 3 switch model, Burling Model E is recommended for use (a) where load is divided into 3 parts, (b) where 1 switch is used for controlling, one as a high limit, one as a low limit, (c) to give definite stops or position to a 3 or 4 position diaphragm motor, (d) to give 3 speed control of variable speed motor.

- **Accurate, Rugged, Dependable**
- **Corrosion and heat resisting tube**
- **Dial Pointer for easy setting**
- **Locking screw locks temperature setting**
- **Terminal plate has large screw terminals**
- **Snap-action Micro-Switch eliminates contact troubles**
- **Increased Adjustable range to 700-1000°**
- **Dimensions—7¼" x 2¾" x 3½"**

MODEL V-1

For lower temperature range from 0-300°F. Available for minimum of —100° to maximum of 600° F. Usual adjustable range 50-150°, operating differential may be as small as ±¼ or as large as ±5°. Adjustable by screw and dial inside case. (Sizes 2¾" diameter x 4¼" high).

MODEL D

Adjustable range 200-500°F. Temperature range 0-1400°F. For use where temperature must be changed to suit operating conditions. Turn outside knob to change temperature setting. (Sizes 5½ x 2¾ x 2¾").

Instruments also Built to Specifications

Making Precision Controls for Over 12 Years

BURLING INSTRUMENT CO.
251C Springfield Ave.
Newark, N. J.

CONTROLLERS, AUTOMATIC, Stoker (See Controllers, Automatic, Furnace)

CONTROLLERS, AUTOMATIC, Strain-Rate & Stress-Rate
Bailey Meter Co.
Baldwin Locomotive
Hathaway Inst. Co.

CONTROLLERS, AUTOMATIC, Synchronizing (See Regulators)

CONTROLLERS, AUTOMATIC, Tachometric
Abrams Instrument
Allen-Bradley Co.
Askania Regulator Co.
Atomic Instrument
Automatic Temp. Control
Bailey Meter Co.
Barbour Stockwell Co.
Bristol Co.
Brown Inst. Div.
Burlington Inst. Co.
Cutler-Hammer, Inc.
Electric Tachometer
Flight Research Eng.
Foxboro Co.
General Elec. Co.
General Radio Co.
General Regulator Corp.
Hagan Corp.
Hays Corp.
Jones Motorola Corp.
Leeds & Northrup
Lewis & Co., J. B.
Mason-Neilan Regulator
Maxson Corp.
Metron Instrument
Moisture Register Co.
Monitor Controller Co.
Republic Flow Meters
Robinette Co., W. C.
Servo Corp. of America
Servo-Tek Products
Shallcross Controls
Varo Mfg. Co.
Viking Instruments
Ward Leonard
Westinghouse Elec.

CONTROLLERS, AUTOMATIC, Temperature (See Pyrometric above or Thermometric below)

CONTROLLERS, AUTOMATIC, Temperature-Time (See Controllers, Automatic Thermometric; Controllers, Automatic, Thermostatic; Controllers, Automatic, Time)

CONTROLLERS, AUTOMATIC, Thermometric
American Inst. Co.
Amer. Temp. Ind.
Ashcraft Auto. Cont.
Assembly Products
Automatic Temp. Control
Bailey Meter Co.
Barber-Colman
Bristol Co.
Brown Inst. Div.
Burling Inst. Co.
Clark-Cooper Co.
Commercial Research
Dickson Co.
Douglass Automatic
Edison Electrical Controls
Electrimatic Corp.
Electro Medical Lab.
Electo-Tech. Equip.
Emerson Apparatus Co.
Emmett Machine
Fisher Governor
Fish-Schurman Co.
Foster Engg. Co.
Foxboro Co.
Fuel Watchman
Fulton-Sylphon
General Controls
General Elec. Co.
General Regulator Corp.
Gotham Inst. Co.
Hagan Corp.
H-B Inst. Co., Inc.
Illinois Testing Labs.
Kessler Co.
Klipfel Mfg.
Leeds & Northrup
Leslie Co.
Manning, Maxwell & Moore
Marsh Corp.
Mason-Neilan Reg. Co.
McAlear Mfg. Co.
Minneapolis-Honeywell
Moeller Instrument Co.
Moisture Register Co.
Moore Products
Paragon Electric Co.
Parks-Cramer Co.
Partlow Corp.
Precision Scientific
Precision Therm.
Refinery Supply Co.
Republic Flow Meters
Revere Corp.
Robinette Co., W. C.
Rubicon Co.
Scientific Inst. Co.
Spence Engineering Co.
Stevens Mfg. Co.
Taco West Corp.
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Thwing-Albert Inst. Co.
Trerice Co.
United Elec. Controls
Valverde Labs.
Weksler Thermometer
Wheelco Inst. Co.
Wood, Harry W.

CONTROLLERS, AUTOMATIC, Thermostatic
Allen-Bradley Co.
American Inst. Co.
Accuracy Scientific Inst.
Askania Regulator Co.
Atlas Valve Co.
Automatic Temp. Control
Bailey Meter Co.
Barber-Colman Co.
Betts & Betts
Bockel & Co.
Bristol Co.
Bolfer Room Equip.
Brown Inst. Div.
Burling Inst. Co.
Cook Electric Co.
Cramer & Co., Inc.
Cutler-Hammer Inc.
Dickson Co.
Doelcam Corp.
Edison Electrical Controls
Electric Hotpack Co.
Fenwal, Inc.
Fisher-Governor
Fish-Schurman Co.
Foster Eng. Co.
Foxboro Co.
Fuel Watchman
Fulton Sylphon Co.
General Controls Co.
General Elec. Co.
Gleason Avery, Inc.
Gotham Inst. Co.
Hagan Corp.
Hammel-Dahl Co.
H-B Inst. Co.
H & H Themostats
Hart Mfg. Co.
Industrial Engr. Corp.
Instrument Rep. & Mfg.
Johnson Service Co.
Keckley Mfg. Co.
Kiely & Mueller
Klipfel Mfg. Co.
Leslie Co.
Manning, Maxwell, Moore
Marsh Corp.
Mercoid Corp.
Minneapolis-Honeywell
Moiture Register Co.
Mu-Switch Corp.
Partlow Corp.
Perfex Corp.
Phila. Thermometer Co.
Powers Regulator Co.
Precision Scientific
Precision Therm.
Preferred Utilities
Rascher & Betzold
Republic Flow Meters
Robinette Co., W. C.
Ruggles Klingemann
Sampsel Time Control
Sarco Co., Inc.
Smith Control & Inst.

(Continued)

Spence Engineering Co.
Sterling Inc.
Stevens Mfg. Co.
Struthers-Dunn
Swartwout Co.
Tagliabue Corp., C. J.
Taylor Inst. Co.
Trerice Co.
United Elec. Controls
Valverde Labs.
Vaughn-G. E. Witt Co.
Viking Instruments
Weston Elec. Inst. Corp.
White Mfg. Co.
White-Rodgers Elec. Co.

CONTROLLERS, AUTOMATIC, Time
Abrams Instrument
Allen-Bradley Co.
Am. Gas Accumulator
American Timer Corp.
Automatic Elec. Mfg. Co.
Automatic Temp. Control
Bailey Meter Co.
Barber-Colman
Betts & Betts
Bristol Co.
Brown Inst. Div.
Cincinnati Time Rec.
Clare & Co.
Controls, Inc.
Counter & Control Corp.
Cramer Co., Inc.
Cutler-Hammer, Inc.
Eagle Signal orp.
Edison Electrical Prods.
Electric Hotpack Co.
Electronic Controls
Emmett Machine
Fisher Governor
Foxboro Co.
Fredericks Co., Geo.
Friez Instrument
Fuel Watchman
General Controls
General Elec. Co.
Gotham Inst. Co.
Guardian Electric Mfg.
Hagan Corp.
Haydon Co., A. W.
Industrial Timer Corp.
Johnson Service Co.
Leeds & Northrup
Lumenite Electronic
Manning, Maxwell, Moore
Mason-Neilan Regulator
Minneapolis-Honeywell
National Time & Signal
Northwestern Clock Co.
Paragon Electric Co.
Partlow Corp.
Perfex Corp.
Photoswitch, Inc.
Photovolt Corp.
Potter Instrument
Powers Regulator Co.

(Continued)

SPECIFY . . .
ATCOTRAN
MULTI-CHANNEL INDICATOR
12 Instruments in 1

Provide the advantages of simple, electrically transmitted intelligences to one focal point for reading: Pressure, Differential Pressure, Force, Flow, etc.

Three scales, each 84" long, with up to 12 measurements on one compact instrument. Linear calibrations for any range or square root scale for flow available. Features:

- Null balance system
- Dead beat response
- 2 second scale travel
- Accuracy—¼ of 1% of readings

Send for full particulars.

Request BULLETIN R-20

atc Industrial Controls
AUTOMATIC TEMPERATURE CONTROL COMPANY, INC.
5208 PULASKI AVENUE · PHILADELPHIA, PENNA.

SPECIFY ATC
Heavy-Duty TIMERS

There is GUARANTEED ACCURACY and reliability for all time and sequence controlled operations, when you are using ATC TIMERS.

Industry's most complete selection of standard types is available from the ATC Timer Line, for controlling the operation of electrical circuits, air cylinders, diaphragms, etc., all featuring compact arrangement, simplified wiring, dependable power, heavy duty components, and ease of operation.

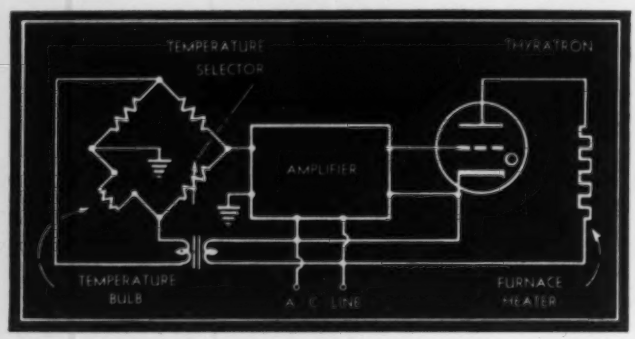
ATC Field Service men will assist you in the selection of TIMERS, and in the development of COMPLETE TIME CONTROL SYSTEMS, to bring increased efficiency to your processing operations or equipment.

Write for full information

atc Industrial Controls
AUTOMATIC TEMPERATURE CONTROL COMPANY, INC.
5208 PULASKI AVENUE · PHILADELPHIA, PENNA.

MACDONALD

PROPORTIONING TEMPERATURE CONTROLLER



Range: Standard — to 1,000° F.
Special — to 1,800° F.
Precision Control: within 0.1° F.
Output: (To heaters)

	Type A	Type B
110 V. 60 cy.	220 VA	825 VA
220 V. 60 cy.	550 VA	1650 VA
Price F.O.B.	$290.00	$375.00

Standard Temperature Bulb — $40.00

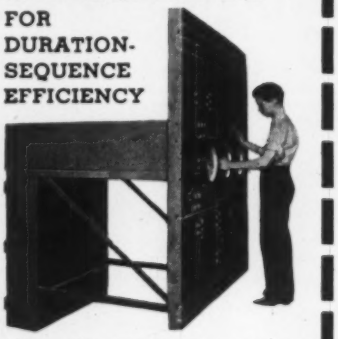
Write for descriptive bulletin.

W. S. MACDONALD CO., INC.
33 UNIVERSITY ROAD
CAMBRIDGE 38, MASSACHUSETTS

SPECIFY ATC

TIME CONTROL SYSTEMS

FOR DURATION-SEQUENCE EFFICIENCY



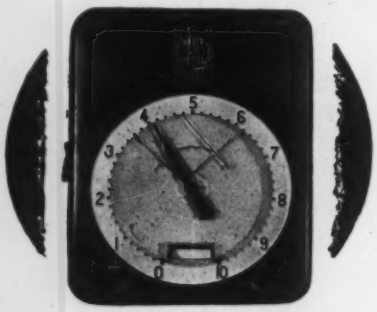
Designed especially for your process or equipment—to bring new efficiency and greater savings to operations in every field where SEQUENCE and DURATION are prime factors.

ACCURATE CONTROL for 1 TO 1000 CONSECUTIVE AND OVERLAPPING MACHINE OR PROCESS FUNCTIONS!

Let the ATC Field Service Representative assist you in the development of an individual factory engineered and assembled TIME CONTROL SYSTEM to suit your process or equipment and space requirements!

Write for full information

atc *Industrial Controls*
AUTOMATIC TEMPERATURE CONTROL COMPANY, INC.
1209 PULASKI AVENUE · PHILADELPHIA, PENNA.



BAILEY

Temperature Controller

● This BAILEY PYROTRON Electronic Resistance Thermometer indicates, records and controls temperatures between −100 F and 1200 F.

As many as four continuous temperature records may be made on a single 12-inch diameter chart. The 29-inch indicating scale is read easily at distances up to fifty feet.

Two recording controllers may be combined in one Bailey Pyrotron to save panel space. Air-operated, electric, or electronic controls are furnished as required.

Each recorder responds instantly since it is controlled by a separate measuring bridge and inertia free electronic detector. A small reversible electric motor balances the bridge and drives the indicating, recording and controlling features.

The temperature sensitive element is a platinum resistance wire wound on a mica form.

Ask for Bulletin 230-B.

BAILEY METER COMPANY
1041 IVANHOE ROAD · CLEVELAND, O.
Bailey Meter Company Ltd., Montreal, Canada

Production Instrument
Rhodes, Inc., M. H.
Rowe Engineering
Sampsel Time Control
Sangamo Elec. Co.
Seely Inst. Co., Inc.
Standard Elec. Time
Stromberg Time Corp.
Struthers-Dunn
Tagliabue Corp., C. J.
Taylor Inst. Co.
Telechron, Inc.
Thomas Clock Co., Seth
Thordarson Elec. Mfg.
Tork Clock Co.
Wadsworth Elec. Mfg.
Walser Automatic Timer
Ward Leonard
Wheelco Insts. Co.
White-Rodgers Elec.
Wilson & Co., G. C.

CONTROLLERS, AUTOMATIC, Vacuum (See Controllers, Automatic, Pressure)

CONTROLLERS, AUTOMATIC, Vacuum (See Valve-Operating Devices)

CONTROLLERS, AUTOMATIC, Viscosity

Bailey Meter Co.
Brabender Corp.
Brookfield Engg. Labs.
Electric Eye Equip.
Fischer & Porter
Foxboro Co.
General Controls
General Elec Co.
Norcross Corp.
Perfex Corp.
Robinette Co.
Scientific Inst. Co.
Taylor Inst. Cos.
Visco-Meter Corp.

CONTROLLERS, AUTOMATIC, Voltage (See Regulators)

CONTROLLERS, AUTOMATIC, Volume (See Controllers, Automatic, Flow)

CONTROLLERS, AUTOMATIC, Water Level (See Controllers, Automatic, Liquid Level)

CONTROLLERS MANUAL (Non-automatic), Field

Allis-Chalmers
Automatic Elec. Mfg.
Betts & Betts
Climax Engineering
Cutler-Hammer, Inc.
General Controls
General Elec. Co.
National Elec. Controler

(Continued)

Ohmite Mfg. Co.
Ward Leonard Elec. Co.
Westinghouse Elec.

CONTROLLERS MANUAL (Non-automatic), Hydaulic

Adel Precision Prods.
Brooks Rotameter
Cash Co.
General Controls
Hagan Corp.
Hammel-Dahl Co.
Hydraulic Controls
Schade Valve Mfg. Co.
Seely Inst. Co., Inc.
Shallcross Controls

CONTROLLERS, MANUAL (Non-automatic) Motor

Allen-Bradley Co.
Allis-Chalmers
Automatic Elec. Mfg.
Betts & Betts
Cutler-Hammer, Inc.
Furnas Electric Co.
General Controls
General Elec. Co.
Heller Co.
Leeds & Northrup
Lindberg Engineering
National Elec. Controler
Ohmite Mfg. Co.
Superior Electric Co.
Ward Leonard Elec. Co.
Westinghouse Elec. & Mfg.
Wilson & Co.

CONTROLLERS, MANUAL (Non-automatic Rheostatic)

Allen-Bradley Co.
Beck Bros.
Cutler-Hammer, Inc.
General Controls
General Elec. Co.
Mallory & Co.
National Elec. Controller
Ohmite Mfg. Co.
Rubicon Co.
Ward Leonard Elec. Co.
Westinghouse Elec.

CONTROL SYSTEMS (See Controllers, Automatic)

COUNTERS, Alarm

Adde & Co.
Automatic Temp. Control
Counter & Control Corp.
Cook Electric
Durant Mfg. Co.
El-Tronics, Inc.
Flett Laboratory
General Electric Co.
Martin-Hubbard Corp.
Mercoid Corp.
Potter Instrument
Production Instrument
Rowe Engineering

COUNTERS, Colony

American Optical
Central Scientific
Fisher Scientific Co.
Sargent & Co.
Thomas Co., Arthur H.

COUNTERS, Cycle

Automatic Elec. Chicago
Automatic Temp. Control
Bawden Bros.
Bristol Co.
Brush Development
Cook Electric
Counter & Control Corp.
Cyclotron Specialities Co.
Electric Speed Indicator
Engineering Res. Assoc.
Foxboro Co.
General Elec. Co.
Gorrell & Gorrell
Hetherington & Son
Hewlett-Packard Co.
Martin-Hubbard Corp.
Paragon Electric Co.
Potter Instrument
Raytheon Mfg. Co.
Rowe Radio Research
Standard Elec. Time Co.
States Co.
Telechron, Inc.
Westinghouse Elec.

COUNTERS, Footage

Adde & Co.
Bristol Co.
Cook Electric
Counter & Control Corp.
Durant Mfg. Co.
Elec. Tachometer Corp.
Hetherington & Son
McDonnell Odometer Corp.
Potter Instrument
Production Instrument
Veeder-Root, Inc.
Zernikow Co.

COUNTERS, Geiger-Muller

Abrams Instrument
Atomic Instrument
Ballantine Labs.
Bay Insts. & Dev.
Berkeley Scientific
Cambridge Inst. Co.
Canadian Radium
Cyclotron Specialties
Distillation Products
Eck & Krebs
Eclipse-Pioneer
Electronic Products
El-Tronics, Inc.
Flader, Inc., Frederic
General Electric
Flett Laboratory
General Radio Co.
Geophysical Instrument
Goldak Co.
Herbach & Rademan

(Continued)

Inst. Development Labs.
National Tech. Labs.
North Amer. Philips
Nuclear Dev. Lab.
Nuclear Inst. & Chem.
Potter Instrument
Radiation Counter Labs.
Southwestern Ind. Elec.
Stoelting Co., C. H.
Sylvania Elec. Prod.
Technical Associates
Tracerlab, Inc.
Ultra-Violet Products
Vacutron, Inc.
Victoreen Instrument Co.
Welch Mfg. Co.

COUNTERS, Hour

Automatic Temp. Control
Cramer & Co., Inc.
Elec. Tachometer Corp.
General Elec. Co.
Gorrell & Gorrell
Haydon Co., A. W.
Paragon Electric Co.
Production Instrument
Revere Corp.
Rowe Engineering
Standard Elec. Time
Telechron, Inc.
Westinghouse Elec.
Weston Elec. Inst. Corp.

COUNTERS, Lumber

Adde & Co.
Durant Mfg. Co.
Keuffel & Esser Co.
Lufkin Rule Co.
McDonnell Odometer Co.
Moisture Register Co.
Potter Instrument
Production Instrument

COUNTERS, Photoelectric

Atomic Instrument
Autotron Co.
Berkeley Scientific
Detect-O-Ray
Durant Mfg. Co.
Electronic Prod. Co.
El-Tronics, Inc.
Engineering Res. & Dev.
Ess Instrument Co.
Fisher-Pierce Co.
Flett Lab.
General Electric Co.
Lumenite Electronic
Martin-Hubbard Corp.
Photoswitch, Inc.
Post Machinery
Potter Instrument
Production Instrument
Rowe Engineering
Sherron Metallic
Sticht Co.
Streeter-Amet Co.
Vacutron, Inc.
Veeder-Root, Inc.
Weston Electrical Inst.
Worner Products

ELECTRIC and ELECTRIC-EYE COUNTING

JUST OFF THE PRESS—16-page illustrated bulletin. Describes Modern Methods of Count Controlling Production Packaging, Deliveries, Batch Counting; Remote Production Counting. Send for your copy.

Tremendous aid to improved efficiency

WIZARD Electric Counters count anything that will operate a switch, photo-electric unit, or other circuit-breaking device. You can locate them at any distance from the actual source of count. Operations thruout the plant can be counted in Production Office.

Models for every purpose. Just tell us what you want to do.

Production Instrument Company
702 W. JACKSON BLVD., CHICAGO 6, ILL.
Representatives in Principal Cities

A RECORDING MECHANICAL COUNTER

THAT MEETS ALL INDUSTRIAL REQUIREMENTS

Operates on the output of a photo-electric cell, limit switch or any similar device. Records production against time and maintains a permanent record on a 2¼" tape. Automatically resets to zero every hour.

Here is a step in production counting that permits a complete analysis of efficiency in terms of hours or minutes instead of shifts, days or weeks. The reset feature eliminates much computation. It simplifies the entire task of studying production flow and determining how to maintain a high production level.

Write for bulletin.

STREETER-AMET COMPANY

AUTOMATIC WEIGHT RECORDERS & SCALES
HIGH SPEED COUNTERS *SINCE 1888*

4101 Ravenswood Ave., Chicago 13, Illinois

COUNTERS, Production
Abrams Instrument
Adde & Co.
Atomic Instrument
Automatic Elec. Chicago
Autotron Co.
Berkeley Scientific
Bristol Co.
Cincinnati Time Recorder
Clarkston Corp.
Clay-Adams Co.
Cook Electric
Counter & Control Corp.
Cramer & Co., Inc.
Cyclotron Specialties
Detect-O-Ray
Durant Mfg. Co.
Elec. Tachometer Corp.
Electronic Controls
General Electric Co.
Gorrell & Gorrell
Guardian Elec.
Hart Mfg. Co., R. E.
Hetherington & Son
Instrument Lab., Inc.
Lansing Engineering
McDonnell Odometer Co.
Moisture Register Co.
Potter Instrument
Production Inst. Co.
Redington Co.
Richardson Scale Co.
Rowe Radio Research
Shalleross Mfg.
Standard Elec. Time
Streeter-Amet Co.
Struthers Dunn
Veeder-Root, Inc.

COUNTERS, Revolution
Adde & Co.
Associated Research
Automatic Temp. Control
Bristol Co.
Boulin Instrument Corp.
Brown & Sharpe
Cook Electric
Counter & Control Corp.
Cummings Machine Wks.
Cyclotron Specialities
Durant Mfg. Co.
Elec. Tachometer Corp.
General Radio
Gurley, W. & L. E.
Hart Mfg. Co., R. E.
Ideal Commutator
Industrial Timer Corp.
Jaeger Watch Co.
Jones Motrola Sales Co.
Knopf Instrument
Marsh Corp., Jas. P.
Mason-Neilan Regulator
McDonnell Odometer Co.
Millers Falls
Moisture Register Co.
Potter Instrument

(Continued)

Production Inst. Co.
Redington Co.
Scherr Co., Inc., George
Standard Elec. Time Co.
Starrett Co., L. S.
Taller & Cooper
Veeder-Root, Inc.
Warren-Knight Co.
Zernickow Co., O.

COUNTERS, Stroke
Adde & Co.
Automatic Temp. Control
Bristol Co.
Clay-Adams Co.
Cook Electric
Counter & Control Corp.
Durant Mfg. Co.
Eagle Signal Corp.
Gorrell & Gorrell
Guardian Elec. Mfg. Co.
Hart Mfg. Co., R. E.
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International Register Co.
McDonnell Odometer Co.
Moisture Register Co.
Potter Instrument
Production Inst. Co.
Redington Co.
Streeter-Amet Co.
Taller & Coper
Veeder-Root, Inc.

COUNTERS, Twist
McDonnell Odometer Co.
Potter Instrument
Scott Testers, Inc.
Suter, Alfred
Veeder -Root, Inc.

COUNTERS, Vehicular
Aristo Import Co.
General Electric
Knopf Instrument
Streeter-Amet Co.
Taller & Cooper
Veeder-Root, Inc.

COURSE PROTRACTORS (See Protractors, Course)

CRYSTALS, Piezoelectric
Bausch & Lomb Opt.
Bliley Electrical Co.
Brush Development Co.
Crystal Research Labs.
Dearborn Scientific
General Elec. Co.
General Radio Co.
Knights Co.
North Amer. Philips
Premier Crystal Labs.
RCA Div
Reeves Hoffman Corp.
Standard Arcturus
Standard Piezo Co.
Valpey Crystals

CRYSTALS, Quartz
Bliley Electric Co.
Crystal Research Labs.
Dearborn Scientific
Fecker, Inc.
Federal Telegraph Co.
Flett Laboratory
Fuess, Inc.
General Elec. Co.
General Radio Co.
Harvey Radio Labs.
Knights Co.
North Amer. Philips
Premier Crystal Labs.
RCA Div.
Reeves Hoffman Corp.
Standard Arcturus
Standard Piezo Co.
Unertl Optical Co.
Valpey Crystal Corp.
Western Electric

CRYSTALS, Rochelle Salt
Brush Development Co.
Dearborn Scientific
Fecker, Inc.
Unertl Optical Co.
Wallace & Tiernan

CRYSTALS, Tourmaline
Dearborn Scientific
Flecker, Inc.
Fuess, Inc.
Premier Crystal Labs.
Unertl Optical Co.
Valpey Crystal Corp.
Zeiss, Inc., Carl

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RCA Manufacturing
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CURRENT REGULATORS (See Regulators, Current)

CURVE TRACERS (See Drawing Instruments)

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Moeller Inst. Co.
Trimount Inst. Co.
Varo Mfg. Co.

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DEFORMETERS
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Dietert Co.

DEMAND, Indicators See Meters, Demand, Electric; Meters, Demand, Gas)

DEMAND, Recorders (See Meters, Demand)

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Permutit Co.
Pfaltz & Bauer, Inc.
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Tagliabue Corp., C. J.

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Baird Associates
Bausch & Lomb Opt.
Cambridge Instrument
Dearborn Scientific
Eastman Kodak Co.
Ferner Co.
Fish-Schurman Corp.
Fisher Scientific
Gaertner Scientific Corp.
General Elec. Co.
Hayes Scientific
Jarrell-Ash Co.
Mico Inst. Co.
Permutit Co.
Photovolt Corp.
Precision Thermometer
Weston Elec. Inst.

DENSOMETERS
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Gaertner Scientific Corp.
Gurley, W. & L. E.
Permutit Co.
Weksler Thermometer
Zeiss, Inc., Carl

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Amer. Measuring Insts.
Chicago Dial Ind. Co.
Federal Prod. Corp.
Gen. Engg. & Model Wks.
Lufkin Rule
Maveg Machine Sales
Rimat Co.
Size Control Co.

DEPTH INDICATORS, Sea (See Gages, Liquid Level, Indicating)
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Hagan Corp.
Kahl Sci. Inst. Co.
Moeller Inst. Co.
Negus, T. S. & J. D.
Trimount Inst. Co.

DEPTH, Recorders, Liquid (See Gages, Liquid Level, Indicating)

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Sperry Products, Inc.

DETECTORS, Benzol
Baird Associates
Bristol Co.
Davis Emergency Equip.
Mine Safety Appliances

DETECTORS, Carbon Monoxide
Baird Associates
Bristol Co.
Davis Emergency Equip.
Mine Safety Appliances
Taller & Coper

DETECTORS, Combustible Gas
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Baird Associates
Bristol Co.
General Electric Co.
Johnson-Williams, Ltd.

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American Communications
Bay Insts. & Dev.
Clark Cooper Co.
Edison, Inc., Thos. A.
Fenwal, Inc.
Photoswitch, Inc.
Rowe Engineering

DETECTORS, Flaw
Branson Instrument
Magnaflux Corp.
Magnetic Analysis Corp.
Sperry Products, Inc.

DETECTORS, Gas
Baird Associates
Bristol Co.
Bullard Co.
Davis Emergency Equip.
General Elec. Co.
Heiland Research
Johnson-Williams
Mine Safety App. Co.
Nuclear Inst. & Chem.
Process & Instruments

DETECTORS, Hydrogen Sulphide
Baird Associates
Davis Emergency Equip.
General Elec. Co.
Mine Safety Appliances

DETECTORS, Leak (See Gas Leak Indicators)

DETECTORS, Lie
Associated Research
Electro-Medical Labs.
Flett Lab.
Stoelting Co., C. H.

DETECTORS, Mercury Vapor
Central Scientific
General Elec. Co.
Mine Safety Appliances

DETECTORS, Metal
Associated Research
Du Mont Labs., Inc.
Fisher Research Lab.
General Elec. Co.
Geophysical Inst. Co.
Goldak Co.
Illinois Testing Labs.
McFarlin Co.
Radio Frequency Labs.
RCA Div.
Rowe Engineering
Streeter-Amet Co.
Wilmotte, Inc.

DETECTORS, Methane
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Bristol Co.
Bullard Co., E. D.
Davis Emergency Equip.
Heiland Research
Johnson-Williams
Mine Safety Appliances

DETECTORS, Microwave
Sperry Products
Sylvania Electric Prod.

DETECTORS, Mine Gases
Davis Emergency Equip.
Heiland Research
Mine Safety Appliances

DETECTORS, Oxygen, Deficiency
Davis Emergency Equip.
General Elec. Co.
Mine Safety Appliances

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Geophysical Inst. Co.
Littelfuse Labs.
Mineralac Electric Co.
Sensitive Research Inst.
Varo Mfg. Co.
Westinghouse Elec.

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Bay Insts. & Dev.
Berkeley Scientific
Canadian Radium
Cyclotron Specialities
Distillation Products, Inc.
General Elec. Co.
General Radio Co.
Geophysical Instrument
Goldak Co.
Herbach & Rademan
Nuclear Instrument
Radiation Counter Labs.
Scott, Inc., Hermon
Southwestern Ind. Elec.
Sylvania Elec. Prod.
Technical Associates
Tracerlab, Inc.
Victoreen Inst. Co.
Wood Counter Lab.

DETECTORS, Radium
American Inst. Co.
Bay Insts. & Dev.
Berkeley Scientific
Canadian Radium
El-Tronics, Inc.
Fisher Research Lab.
Flett Lab.
Geophysical Inst. Co.
General Electric Co.
Goldak Co.
Kelly-Koett
National Tech. Labs.
Nuclear Dev. Lab.
Nuclear Inst. & Chem.
Radiation Counter Labs.
Rowe Engineering
Scott, Inc., Hermon
Technical Associates
Tracerlab, Inc.
Wood Counter Lab.

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DETECTORS, Voltage
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Freed Transformer
General Elec. Co.
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Illinois Testing Labs.
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Refinery Supply Co.
Surface Combustion
Welch Scientific

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Brown & Sharpe
Chicago Dial Ind. Co.
Deming Indicator
Do All Co.
Federal Prod. Corp.
Ferner Co.
General Elec. Co.
Gen. Engg. & Model Wks.
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Gaertner Scientific Corp.
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Leitz, Inc., E.
Maveg Mach. Sales
Rockwell Co., Stanley P.
Sylvania Elec. Labs.
Zeiss, Inc., Carl

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Daven Co.
Electronic Dev. Lab.
General Radio
Gray Instrument
Shallcross Mfg.
Thwing-Albert Inst. Co.
Ward Leonard Elec. Co.

DIVIDERS, Voltage (Radio Frequency)
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Daven Company
Electronic Associates
Ferris Inst. Co.
General Elec. Co.
General Radio Co.
Instrument Resistors, Inc.
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Potter Instrument
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DRAFT Controllers (See Controllers, Automatic Draft)

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Millers Falls Co.
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Post Co., Frederick
Rapidesign Inc.
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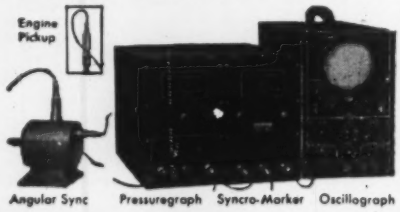

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Sargent & Co.
Scientific Glass Apparatus
Scientific Inst. Co.
Wilson Products, Inc.
Zeiss, Inc., Carl

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Dynamatic Corp.
Emery Co., A. H.
Link Engineering
Olsen Testing Machine
Taylor Dynamometer

DYNAMOMETERS, Pull Rod
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Conoflow Corp.
Dillon & Co.
Hathaway Inst. Co.
Hayes Scientific Apps.
Schaevitz Engg.
Seederer-Kohlbusch, Inc.
Statham Labs.
Stoelting Co., C. H.

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Cole Instrument
Dynamatic Corp.
General Elec. Co.
L. A. B. Corp.
Link Engineering
Mid-West Dynamometer

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Dillon & Co.
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Hathaway Inst. Co.
Olsen Testing Machine
Riehle Div.
Schaevitz Engg.
Seederer-Kohlbusch
Statham Labs.
Stoelting Co., C. H.
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Hathaway Instrument
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Link Engineering
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Biddle Co., Jas. G.
Borden Engineering
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Gray Instrument
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Sherron Metallic

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Rawson Elec. Insts.
Welch Scientific
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Nuclear Inst. & Chem.
Pfaltz & Bauer, Inc.
Rawson Elec. Inst.
Rubicon Co.
Testrite Instrument Co.
Welch Mfg. Co.

ELECTROMETERS, String
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Dearborn Scientific
Geophysical Inst. Co.
Nuclear Inst. & Chem.
Pfaltz & Bauer, Inc.
Victoreen Instrument Co.

ELECTROMETERS, Vibrating Reed
Applied Physics Corp.
Furst Electronics

ELECTRONIC METERS (See Meters, Electronic)

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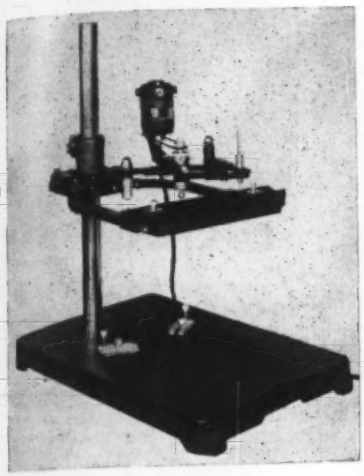

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Fischer & Porter
Foxboro Co.
Hagan Corp.
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Republic Flow Meters
Simplex Valve & Meter
Spearling, R. W.

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Hellige, Inc.
Industrial Insts., Inc.
LaMotte Chemical Prod.
Leeds & Northrup Co.
Palo-Myers
Pfaltz & Bauer, Inc.
Photovolt Corp.
Taylor & Co., W. A.

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Builders-Providence
Fischer & Porter
General Controls
Gump Co., B. F.
Henszey Co.
Merrick Scale
Milton Roy Pumps
Omega Machine
Permutit Co.
Proportioneers, Inc.
Schaffer Poidometer
Wallace & Tiernan

FEEDERS, Automatic Granular Material
Builders-Providence
Federal Classifier
Gump Co., B. F.
Merrick Scale
Omega Machine
Permutit Co.
Proportioneers, Inc.
Schaffer Poidometer

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General Elec. Co.
McFarlin Co.
Measurements Corp.
Panoramic Radio Co.
RCA Div.
Sherron Metallic
Tobe Deutschmann Corp.
Waugh Labs.

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Allis-Chalmers
Anderson Bros. Mfg. Co.
Automatic Scale
Bowser & Co.
Gump Co., B. F.
Potter Instrument
Proportioneers, Inc.
Richardson Scale Co.
Stokes & Smith Co.
Triangle Package Mach.

FILTER, Instrument Air
Hankison Corp.

FILTERS, Light (See also Filters, Optical)
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Baird Associates
Bausch & Lomb Opt.
Bell & Howell
Bolsey Corp.
Central Scientific Co.
Corning Glass Works
Crystal Research Labs.
Dearborn Scientific
Fish-Schurman Co.
Fuess, Inc.
Goerz Amer. Optical Co.
Kollmorgen Optical Co.
Leitz, Inc.
Palos Optical Co.
Perkin-Elmer Corp.
Zeiss, Inc., Carl

FILTERS, Optical
Baird Associates
Bausch & Lomb Optical
Binswanger & Co.
Boehmke Optical Co.
Bolsey Corp.
Crystal Research Labs.
Dearborn Scientific
Eastman Kodak Co.
E & S Optical
Ferner Co.
Fecker, J. W.
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General Scientific Corp.
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Goerz Amer. Optical Co.
Hayward Optical Glass
Henson Co., Fred C.
Jones Optical Works
Kiett Mfg. Co.
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Pfaltz & Bauer, Inc.
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Photovolt Corp.
Pyrometer Inst. Co.
Rubicon Co.
Schneider-Cogswell
Simpson Optical Mfg.
Testrite Instrument Co.
Triumph Mfg. Co.
Unertl Optical Co.
Univis Lens Co.

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Globe Phone Mfg.
Goldak Co.
Wilder, R. S.

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General Elec. Co.
H-B Instrument
Instrument Dev. Lab.
Kollmorgen Optical Co.
Martin-Hubbard Corp.
Maxson Corp.
Perkin Elmer Corp.
Robinette Co., W. C.
Sperry Gyroscope Co.
Unertl Opt. Co.

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FLATNESS TESTERS (See Testers, Flatness, Light Wave)

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American Optical
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Baird Associates
Bausch & Lomb Optical
Binswanger & Co.
Buechele, W.
Central Scientific Co.
Clark & Sons
Crystal Research Labs.
Dearborn Scientific Co.
DoAll Co.
Dome Precision
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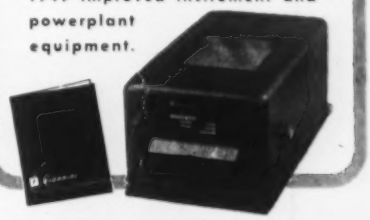
Fecker, Inc.
Ferner Co.
Fish-Schurman Co.
Fuess, Inc.
Gaertner Scientific Corp.
General Scientific Corp.
Geophysical Inst. Co.
Glendale Optical
Goerz Amer. Optical Co.
Henson Co., Fred C.
Howland Optical Works
Jarrell-Ash Co.
Jones Optical Works
Kollmorgen Optical Co.
Master Optical Co.
Mico Instrument Co.
Miller Corp., William
Optron Laboratory
Palos Optical Co.
Perkin-Elmer Corp.
Phoenix Prec. Inst.
Plummer & Kershaw
Pratt & Whitney
Ruska & Co.
Scherr Co., Inc., George
Schneider-Cogswell
Sheffield Corp.
Simpson Optical
Tinsley Laboratories
Unertl Optical Co.
Univis Lens Co.
Van Keuren Co.
Vinco Corp.
Wilder, R. S.
Zenith Optical Co.
Zeiss, Inc., Carl

FLIGHT DATA RECORDER

Flight Recorder 9921 is a continuous-strip recording instrument designed for use with Giannini end-instruments such as accelerometers, altitude transmitters, directional transmitters, etc.

Recently expanded manufacturing facilities afford firm delivery of 1949 improved instrument and powerplant equipment.



Latest Technical Catalogs on Request

G. M. Giannini & CO. INC.
285 W. Colorado, Pasadena 1, California
697 Morris Turnpike, Springfield, N. J.

for wind tunnels and aeronautical research

MACH-ZEHNDER
INTERFEROMETER AND SCHLIEREN METHOD SYSTEMS

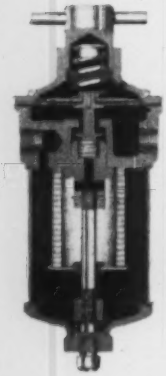
of guaranteed performance

WIND TUNNEL WINDOWS
PRECISION MIRRORS
OPTICAL FLATS

OPTRON LABORATORY
2725 Salem Ave.
Dayton 6, Ohio

PACKAGED
REGULATOR—FILTER
Conoair PAK

FOR INSTRUMENT SUPPLY SERVICE



Combines functions of a quality air filter and high-grade reducing valve into a small compact unit which reduces installation time, space and cost.

Forged brass construction for corrosion resistance. Available in a variety of ranges, filter areas and dripwell capacities.

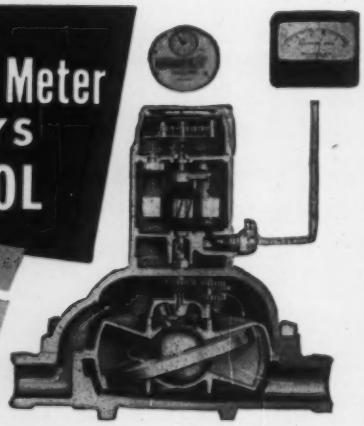
Write for Bulletin FH-15.

CONOFLOW CORPORATION, 2100 ARCH ST., PHILA. 3, PA.

INDUSTRIAL
PNEUMATIC
Cono Controls

HAYS
VERIFLOW Meter
and HAYS
VERITROL

MEASURE...
INDICATE...
TOTALIZE...
CONTROL...



the FLOW OF PRACTICALLY ALL LIQUIDS

Maintaining the proper flow of liquid is a relatively simple job once a Hays Veriflow Meter and Hays Veritrol Controller are installed. They supplant guesswork with dependably accurate measurement and control of both the rate of flow and total flow of practically any piped fluid. What's more, the rate-of-flow indicator is designed for remote reading. Result: accurate measurement, product control, cost control, uninterrupted service. If you make or use liquid in volume it will pay you to consider this modern flow meter. WRITE FOR BULLETIN 48-766.

The HAYS CORPORATION
Since '92
COMBUSTION & INDUSTRIAL INSTRUMENTS & CONTROLS
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FLATZ, OPTICAL, Fused Quartz
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American Lens
Bausch & Lomb Opt.
Crystal Research Labs.
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DoAll Co.
Dome Precision
E & S Optical
Fecker, Inc.
Fish-Schurman Corp.
Gaertner Scientific
Geophysical Inst. Co.
Henson Co., Fred C.
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Jones Optical Works
Optron Laboratory
Palos Optical Co.
Perkin-Elmer Corp.
Phoenix Prec. Inst.
Plummer & Kershaw
Scherr Co., Inc.
Sheffield Corp.
Simpson Optical Mfg.
Thermal Syndicate Ltd.
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Van Keuren Co.

FLIGHT TEST INSTRUMENTS
Electronic Associates
Federal Telegraph Co.
Gannon Co.
General Elec. Co.
Hathaway Instrument
Heiland Research
Impact Register
Lewis Engineering
M. B. Mfg. Co.
Revere Corp.
Sperry Gyroscope Co.
Statham Labs.
Televiso Products

"FLOW"

(Flowmeters measure primarily RATE of flow. For positive or "quantity" fluid meters, see the numerous classes under "Meters")

FLOWMETERS, AIR
(See Flowmeters, Gas)

FLOWMETERS, AREA
Cone & Disk Type
Commercial Research
Fischer & Porter
Friez Instruments
Hays Corp.
National Meter Co.
Phoenix Precision Inst.

FLOWMETERS, AREA
Cylinder & Piston Type
American Inst. Co.
Bowser & Co.
Brown Inst. Co.
Fischer & Porter
Hays Corp.
National Meter Co.
New Jersey Meter Co.
Phoenix Precision Inst.

FLOWMETERS, AREA, Free Float Type
Brooks Rotameter
Commercial Research
Fischer & Porter
Fish-Schurman Corp.
Hammel-Dahl Co.
Hays Corp.
Hoke, Inc.
Mercury Glass Co.
Penn. Ind. Inst. Corp.
Phoenix Prec. Inst.
Schutte & Koerting Co.

FLOWMETERS, AREA
Orifice & Plug Type
American Meter Co.
Bacharach Industrial Inst.
Bailey Meter Co.
Bristol Co.
Brown Inst. Div.
Fischer & Porter
Hays Corp.
Henszey Co.
Mason-Neilan Regulator
Meriam Inst. Co.
Republic Flow Meters
Robinson Orifice
Simplex Valve & Meter
Taylor Inst. Cos.
Trimount Instrument

FLOWMETERS, BLAST
(See Flowmeters, Gas)

FLOWMETERS, GAS
Ace Glass, Inc.
American Dist. Steam
American Inst. Co.
American Meas. Insts.
American Meter Co.
Automatic Temp. Cont.
Bacharach Industrial Inst.
Bailey Meter Co.
Barton Inst. Co.
Bethlehem Fdry. & Mach.
Bowser & Co.
Bristol Co.
Brooks Rotameter
Brown Inst. Div.
Builders-Providence
Clark Blast Meter
Commercial Research
Cook Electric
Corning Glass Works
Eclipse-Pioneer Div.
Electric Heat Control
Elec. Indicator Corp.
Fischer & Porter
Fish-Schurman Co.
Foxboro Co.
Friez Instrument
Gas Appliance Specialties
General Elec. Co.
Giannini & Co.
Hagan Corp.
Hastings Inst. Co.

(Continued)

BAILEY
Fluid Meters
For STEAM · LIQUIDS · GASES

● Bailey Fluid Meters are designed to indicate, record and integrate the flow of steam, liquids, or gases under practically any pressure or temperature condition.

A great variety of indicating, recording and integrating combinations are available for use with four distinct types of flow mechanisms.

This large variety of possible combinations enables the flow meter engineer to specify equipment which is pre-eminently suited to any flow measuring application.

When it is desired to place indicators, recorders and integrators at a considerable distance from the primary element, Bailey Synchro-Meters are available to provide electric transmission.

For detailed information consult Sweet's Engineering Catalogs or request a copy of bulletin No. 301.

BAILEY METER COMPANY
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Bailey Meter Company Ltd., Montreal, Canada

REPUBLIC
FLOW METERS

Republic electrical type flow meters are available for measuring the flow of all types of liquids and gases. Meter bodies are built for metering fluids at line pressures up to 10,000 lb. per sq. in. and for all ranges of differential pressure. The reading instruments — indicator, recorder and integrator—are of the remote reading type and can be located any distance from the point of flow measurement.

WRITE FOR DATA BOOK No. 701

REPUBLIC FLOW METERS CO.
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REPUBLIC
INSTRUMENTS • CONTROLS

AMERICAN METER COMPANY

INCORPORATED (ESTABLISHED 1836)

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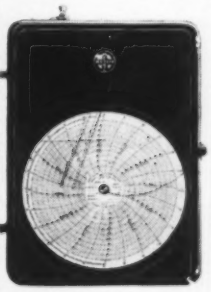
MEASUREMENT AND CONTROL OF GASES — OIL — STEAM — AIR — LIQUIDS

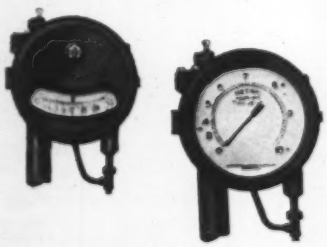
PRODUCTS METERS: Demand, Displacement (Gas or Air), Flowmeters, Indicating, Integrating, Recording, Laboratory, Orifice, Oxygen, Prepayment, Wet and Dry Test, Wide Range Orifice, etc. INDEXES: Base Pressure, Base Volume, Demonstration, etc. CONTROLLERS: Flow, Liquid Level, Pressure, Rate and Volume, Remote Control. GAGES: Differential, Volume and Pressure. REGULATORS: Automatic Gas Cut-Off, Back Pressure, Balanced Valve, Bottled Gas, Gas and Air Pressure, High Pressure, etc. LABORATORY GAS TESTING APPARATUS: Calorimeters, Sulphur and Ammonia Test apparatus, Hydrogen Sulphide Test equipment, 1-10 Cubic Foot Bottles, Wet Test Meters, Dry Governors, Wet Governors, Specific Gravity Apparatus, New Recording Gravitometers, etc.

METRIC ORIFICE METERS AND FLOWMETERS

Indicating—Recording—Integrating



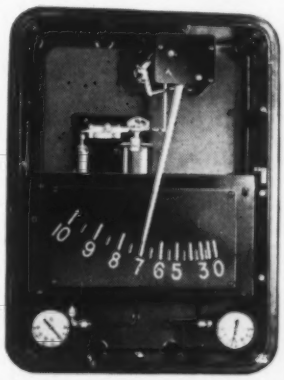
Thousands of American Meter Company's METRIC Orifice Meters based on the famous Westcott Manometer are making year-in-year-out records of sustained accuracy in the petroleum producing and refining fields. Complete engineering installation data is included in current bulletins on METRIC Recording and Integrating Orifice Meters and Flowmeters with description of Intermediate Pressure Connections and Wide Range Orifice.



THE INTEGRATING ORIFICE METER gives a totalized reading of the quantity which has passed through the orifice for all flow rates and all pressure variations. It integrates for static pressure as well as for differential.

THE INTEGRATING FLOWMETER charts a totalized reading of the quantity of gas or steam at constant pressure—or for liquids, regardless of the rate.

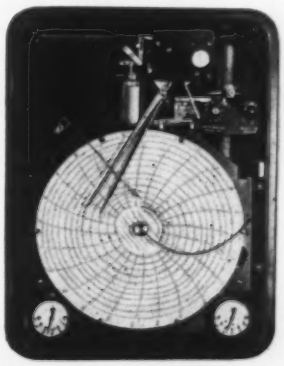
MODEL A-88 PNEUMATIC TRANSMITTER AND CONTROLLER



Many maintenance and servicing problems are answered by the A-88 pneumatic Transmitter and Controller operating on standard 3-15 psi air pressure range.

In addition to a high degree of interchangeability of parts and sub-assemblies, the following important features are included:

1. **NO NEED TO BREAK TUBING CONNECTION** for nozzle adjustment.
2. **INSTRUMENT CAN BE REVERSED** by shifting one link without disturbing other adjustments.
3. **LINKAGE ALIGNMENT MADE EASY IN FIELD** with positioning device.
4. **MAXIMUM PROPORTIONAL BAND CHANGES** with minimum output pressure changes.
5. **EASY POSITIONING OF NOZZLE** permits widening of proportional band without disconnecting tubing, or disturbing other adjustments.
6. **DAMPENING DEVICE IN RELAY** insures smooth operation.
7. **EASY POSITIONING OF LINKAGE MECHANISM** by means of housed proportioning bellows incorporating knurled wheel (with locking device).
8. **LINEAR ADJUSTMENT** between transmitter and receiver.



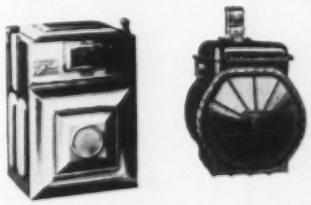
DRY TEST METERS

The operating mechanism of dry test meters is actuated by diaphragms. The meters are used to measure gas unsaturated with water vapor and are designed to meet the requirements of industries using such diversified gases as air, natural and manufactured gas, butane, propane, high gasoline content gases, hydrogen, oxygen, and acetylene, either dry or moist.

WET TEST METERS

In laboratory testing of gases every detail of American wet test meters from gage glass to water line marker and chromium plated pointer insures not only more precise reading . . . quickly . . . but insures continued accuracy of operation for many years.

DISPLACEMENT METERS



The complete Ironcase line ranges from the small, low-pressure 5-B type to high-pressure meters of maximum capacity.

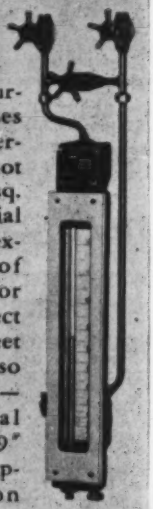
RELIANCE GAS REGULATORS

A complete line of high and low pressure types and wide range of models. Close control. Minimum pressure loss, ease of servicing and low cost of upkeep.

Full Information Supplied Upon Request

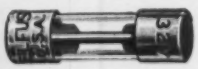
FLOW METERS

● The Type H illustrated is an extremely accurate indicating instrument for measuring the flows of gases or liquids when operating pressures do not exceed 250 lbs. per sq. in. and the differential pressure does not exceed 160 inches of water pressure. Wall or Panel Mounting. Direct reading scales to meet any requirement. Also Inclined Tube types—for low differential ranges of 25" or 49" of water. Fully descriptive catalog sent on request.

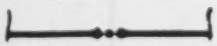


THE MERIAM INSTRUMENT CO.
10958 MADISON AVENUE
CLEVELAND 2, OHIO

Manometers, Meters, and Gauges for the accurate measurement of Pressures, Vacuums and Flows of Liquids and Gases.



Instrument fuses designed for high-speed action. For the protection of delicate electrial equipment.



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4757 Ravenswood Avenue

Chicago 40, Illinois

Hays Corp.
Henszey Co.
Hoke, Inc.
Illinois Testing Labs.
International Filter Co.
King Engg. Corp.
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Leeds & Northrup
Leupold. Voipel & Co.
Linde Air Products
Mason-Neilan Regulator
Meriam Co.
Moore Products
National Meter Co.
New Jersey Meter Co.
Northwest Instrument
Penn Ind. Inst. Corp.
Phoenix Prec. Inst.
Pitometer Log Corp.
Precision Scientific
Refinery Supply Co.
Republic Flow Meters
Revere Corp.
Schutte & Koerting Co.
Scientific Glass Apparatus
Sheffield Corp.
Simplex Valve & Meter
Statham Labs.
Superior Meter Co.
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Trimount Instrument
U. S. Gauge

FLOWMETERS, LIQUID (See Flowmeters, Gas)

FLOWMETERS, Open-Stream
Bailey Meter Co.
Bristol Co.
Builders-Providence
Foxboro Co.
C. M. Mfg. Co.
Hagan Corp.
Hays Corp.
Kahl Sci. Inst. Co.
Leupold & Stevens
Mason-Neilan Regulator
Penn Ind. Inst. Corp.
Republic Flow Meters
Scientific Inst. Co. Calif.
Simplex Valve & Meter
Westberg Mfg. Co.
White Co.

FLOWMETERS, Orifice, and Nozzle
Ace Glass, Inc.
American Dist. Steam
American Meter Co.
Askania Regulator Co.
Bacharach Industrial Inst.
Bailey Meter Co.
Barton Inst. Co.
Bethlehem Fdry. & Mach.
Bristol Co.
Brown Inst. Div.
Builders-Providence
Campbell Co., J. A.
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Corning Glass Works
Daniel Orifice Fitting
Fischer & Porter
Foxboro Co.
Hagan Corp.
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Hoke, Inc.
Leeds & Northrup Co.
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Mason-Neilan Regulator
Meriam Instrument
Moore Products
Penn Ind. Inst. Corp.
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Refinery Supply Co.
Republic Flow Meters
Robinson Orifice
Schutte & Koerting
Scientific Glass Apparatus
Scientific Inst. Co.
Simplex Valve & Meter
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Trimount Instrument

FLOWMETERS, Pilot Tube
Am. Blower Corp.
American Meter Co.
Askania Regulator Co.
Bacharach Industrial Inst.
Bailey Meter Co.
Barton Inst. Co.
Bristol Co.
Cambridge Inst. Co.
Central Scientific Co.
Clark Blast Meter
Defender Automatic Reg.
Dwyer Mfg. Co.
Eclipse-Pioneer Div.
Ellison Draft Gage Co.
Foxboro Co.
Friez Instrument
Hagan Corp.
Hays Corp.
Illinois Testing Labs.
Kollsman Inst. Co.
Leupold & Stevens
Meriam Instrument
Morey & Jones, Ltd.
Pitometer Log Corp.
Precision Therm. & Inst.
Precision Tube Co.
Refinery Supply Co.
Republic Flow Meters
Revere Corp.
Simplex Valve & Meter
Taylor Inst. Cos.
Trimount Instrument

FLOWMETERS, Steam
Am. Dist. Steam Co.
American Meter Co.
Bailey Meter Co.
Barton Inst. Co.
Bethlehem Fdry. & Mach.
Bristol C.
Brown Inst. Div.
Builders-Providence
Fischer & Porter
Foxboro Co.
Hagan Corp.
Hays Corp.
Leeds & Northrup Co.
Mason-Neilan Regulator
Meriam Co.
Moore Products
Penn Ind. Inst. Corp.
Republic Flow Meters
Simplex Valve & Meter
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Trimount Inst.

FLOWMETERS, Vane
Eclipse-Pioneer Div.
Friez & Sons
Hays Corp.
Illinois Testing Labs.
Mason-Neilan Regulator
Simplex Valve & Meter

FLOWMETERS, Venturi-Type
American Meter Co.
Bailey Meter Co.
Barton Inst. Co.
Bethlehem Fdry. & Mach.
Bristol Co.
Brown Inst. Div.
Builders-Providence
Eclipse-Pioneer Div.
Foxboro Co.
Gauther, Donat A.
Hagan Corp.
Hays Corp.
International Filter Co.
Leeds & Northrup
Leupold & Stevens
Mason-Neilan Regulator
Penn Ind. Inst. Corp.
Republic Flow Meters
Simplex Valve & Meter
Taylor Inst. Cos.
U. S. Gauge

FLOWMETERS, Weir
Bailey Meter Co.
Bristol Co.
Brown Inst. Div.
Builders-Providence
Elec. Indicator Corp.
Fischer & Porter
Foxboro Co.
Gurley, W. & L. E.
Hagan Corp.
Hays Corp.
Leupold & Stevens
Mason-Neilan Regulator
Penn Ind. Inst. Corp.
Republic Flow Meters
Simplex Valve & Meter
Taylor Inst. Cos.

FLUE GAS ANALYZERS See Gas Analyzers, Flue Gas)

FLUID METERS, GAS (See Gas Meters)

FLUID METERS, LIQUID (See Meters, Liquid)

FLUID METERS, QUANTITY (See Gas Meters; Meters, Curren; Meters, Liquid)

FLUORESCENT MERCURY VAPOR TUBES EMITTING WHITE LIGHT (See Light Sources)

FLUROMETERS
American Instrument
Coleman Electric
Farrand Optical
National Tech. Labs.
Phoenix Precision Inst.

FLUOROSCOPES
General Electric X-Ray
Kelley-Koett
North American Phillips
Patterson Screen Div.
Picker X-Ray Corp.
Universal X-Ray Prods.
Westinghouse X-Ray Co.

FLUXMETERS
Annis Co.
Associated Research
Cambridge Inst. Co.
Central Scientific Co.
Clarke Inst. Corp.
Clarkston Corp.
Fraser Dev. Lab.
General Elec. Co.
Leeds & Northrup Co.
Marion Electrical Inst.
Rawson Electrical Inst.
Rubicon Co.
Sensitive Research Inst.
Sticht Co.

FOLDING ENDURANCE TESTERS (PAPER) (See Testers, Folding Endurance)

FOOT CANDLE METERS
Central Scientific Co.
De-Jur Amsco Corp.
General Elec. Co.
G-M Labs.
Hickok Elec. Inst.
MB Mfg. Co.
Pfaltz & Bauer, Inc.
Photovolt Corp.
Triplett Elec. Inst.
Welch Scientific
Weston Elec. Inst. Corp.

FOREWARN DETECTOR, for locating hidden weapons (See Detectors, Metal)

FORKS, Synchronization
American Time Prods.
Elec. Tachometer Corp.
Gaertner Scientific Corp.
Leeds & Northrup
MacLeod & Hanopol
Riverbank Laboratories
Times Facsimile Corp.

FORKS, Tuning
American Time Prods.
Bunnell Co., J. H.
Clay-Adams Co.
Gaertner Scientific
General Electric Co.
Goetze Niemer Co.
Hathaway Instrument
Heiland Research
Riverbank Labs.
Times Facsimile Corp.

FORKS, Tuning, Electrically Driven
American Inst. Co.
American Time Prods.
Bunnell Co., J. H.
Cambridge Inst. Co.
Central Scientific Co.
Century Geophysical
Chicago Apparatus Co.
Electronic Prod. Co.
Elec. Tachometer Corp.
Engineering Labs., Inc.
Gaertner Scientific Corp.
General Electric Co.
General Radio Co.
Hathaway Inst. Co.
Leeds & Northrup
Metron Instrument
Riverbank Laboratories
Sherron Metallic
Stoelting Co., C. H.
Times Facsimile Corp.
Varo Mfg. Co.
Welch Mfg. Co.

FORKS, Vacuum Driven
Cambridge Inst. Co.
Gaertner Scientific Corp.
General Radio
Riverbank Laboratories
Times Facsimile Corp.

FRACTIONAL HORSEPOWER MOTORS (See Motors, Fractional Horsepower)

FRACTIONATING COLUMNS, Laboratoy Glass
Glass Engineering Labs.
Kontes Glass Co.
Phoenix Precision Insts.
Uhrig Co., Joseph F.

FREENESS TESTERS (See Testers, Freeness)

FREQUENCY METERS, Controlling
General Elec. Co.
Kellog Switchboard
Leeds & Northrup Co.

FREQUENCY Meters, Electronic
Browning Labs.
Clarke Inst. Corp.
Cole Instrument
Conn, Ltd., C. G.
Daven Co.
De-Jur-Amsco Corp.
Electronic Dev. Lab.
Electro Products Lab.
El-Tronics, Inc.
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Federal Telephone
Feiler Engineering
Furst Electronics
General Elec. Co.
General Radio Co.
Harvey Radio Labs.
Hastings Inst. Co.
Hewlett Packard Co.
Knights Co.
Lampkin Lab.
Lavoie Laboratories
Metron Instrument
Millen Mfg. Co.
Potter Instrument
RCA Div.
Rowe Radio Research
Sherron Metallic

FREQUENCY METERS, Indicating
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Electro-Tech. Equip.
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General Radio Co.
Hagedorn Engineering
Hastings Inst. Corp.
Hathaway Instrument
Hickok Elec. Inst. Co.
J-B-T Instruments
Kellogg Switchboard
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Metron Instrument
RCA Div.
Roller-Smith
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Sperry Gyroscope Co.
Standard Elec. Time
Thordarson Elec. Mfg.
Triplett Elec. Inst.
Varo Mfg. Co.
Westberg Mfg. Co.
West Coast Electronics
Westinghouse Elec.
Weston Elec. Inst. Corp.

FREQUENCY METERS, Microwave
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Electro-Tech Equip. Co.
General Electric Co.
Mico Instrument
Rice's Sons, Inc.
Sperry Gyroscope Co.
Sylvania Elec. Prod.

FREQUENCY METERS, Recording
Bristol Co.
Cole Instrument
Esterline-Angus Co.
General Elec. Co.
Leeds & Northrup Co.
Metron Instrument
Roller-Smith Co.
Sheffield Corp.
Sound Apparatus
Telechron, Inc.
West Coast Electronics
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Crystal Research
Doolittle Radio
Electronic Dev.
Ferris Inst. Co.
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General Radio C.
Hathaway Instru.
Hewlett-Packard
Jacobs Instrument
Knights Co.
Lavoie Laboratori.
Millen Mfg. Co.
Western Electric

FREQUENCY ME RS Vibrating Reed
Aero Instrument
Biddle Co., Jas. G.
Cole Instrument
Furst Electronics
Hagerdorn Engineer.
J-B-T Insts., Inc.
Triplett Elec. Inst.

FREQUENCY MONITORS
Alden Products
Browning Laboratori.
General Electric Co.
General Radio Co.
Hewlett-Packard
Knights Co., James
Lampkin Laboratori.
RCA Div.
Sylvania Elec. Prod.

FREQUENCY RESPONSE RECORDERS, Automatic
Audio-Tone Oscillator
General Elec. Co.
Martin-Hubbard Corp.
Sound Apparatus Co.

FRITTED GLASS FILTERS & APPARATUS
Central Scientific Co.
Corning Glass Works
Electronic Products
Fischer & Porter
Microchemical Service
Mine Safety App. Co.
Pfaltz & Bauer, Inc.
Phoenix Prec. Inst.
Scientific Glass App.

FUEL ANALYSIS APPARATUS
American Inst. Co.
Burrell Tech. Supply Co.
Central Scientific Co.
Eitzen Co.
Fisher Scientific Co.
Hays Corp.
Machlett & Son
Parr Instrument Co.
Precision Scientific Co.
Proportioneers, Inc.
Sargent & Co.
Tagliabue Corp., C. J.

FUEL FLOW INDICATORS
Askania Regulator Co.
Autocall Co.
Bailey Meter Co.
Barton Inst. Co.
Bristol Co.
Brooks Rotameter
Brown Inst. Div.
Commercial Research
Eclipse-Pioneer Div.
Engineering Res. & Dev.
Fischer & Porter
Foxboro Co.
General Elec. Co.
Hastings Inst. Co.
Hays Corp.
Mason-Neilan Regulator
National Airoil Burner
Revere Corp.
Schutte & Koerting
Statham Labs.
Tagliabue
Taylor Inst. Cos.

FURNACE CONTROL SYSTEMS (See Controllers, Automatic)

FURNACES, LABORATORY, HIGH TEMPERATURE
American Instrument Co.
Burrell Tech. Supply
Central Scientific
Dietert Co.
Distillation Products
Electric Hotpack Co.
Ferner Co.
Fisher Scientific Co.
Gordon Co., Claud S.
Hevi Duty Electric
Huppert Co.
Laboratory Equipment
Lindberg Engineering Co.
Machlett & Son
Marshall Co., L. H.
Modern Electrical Lab.
Precision Scientific
R-S Prod. Corp.
Selas Co.
Shallcross Controls
Surface Combustion
Tenney Engineering
Thermo Elec. Mfg. Co.
Thomas Co., Arthur H.

FURNITURE, LABORATORY
Alfab Manufacturing
Aloe Co., A. S.
Browne-Morse Co.
Burrell Technical Supply
Fisher Scientific Co.
Hamilton Mfg. Co.
Kewaunee Mfg. Co.
Laboratory Const. Co.
Laboratory Equipment
Laboratory Furniture Co.
Metalab Equipment
Moline Furniture Works
Sheldon & Co.
Sjostrom Co.
Southern Desk Co.
Welch Scientific

(Continued)

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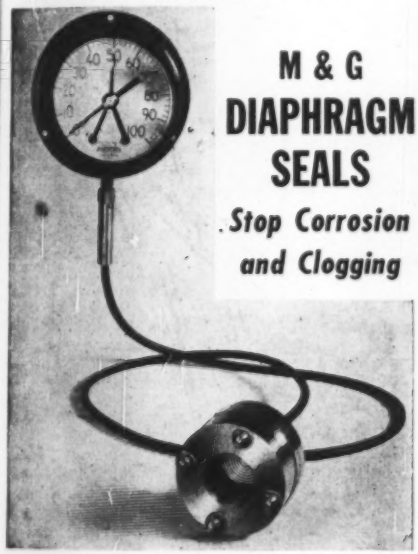
M & G Multi-Purpose PRESSURE GAGE TESTER

- Pressure ranges to 10,000 psi
- Portable or bench testing
- Dead weight attachments
- General instrument work.



M & G DIAPHRAGM SEALS

Stop Corrosion and Clogging

Mount on any type pressure gage, switch, or instrument.

- Pipe Mounting ¼ to 1½ connection — plain & cleanout type.
- Flange type for any size pipe flange connection.
- Available in any machinable metal or material.

Write for Data Sheets

MANSFIELD & GREEN
1051 Power Avenue CLEVELAND 14, O.

FUSES, INSTRUMENT
Kellogg Switchboard
Littelfuse, Inc.
Meter Devices Co.

GAGE BLOCKS
Barr Instrument
Dearborn Gage Co.
Dearborn Scientific
DoAll Co.
Fonda Gage
Ford Motor Co.
Illinois Tool Works
Jansson Gage Co.
Lincoln Park Tool
Pratt & Whitney
Precision Scientific
Scherr Co., George
Size Control Co.
Standard Gage Co.
Swedish Gage
Van Keuren Co.
Webber Gage Co.

GAGE BLOCKS, Angle
Palos Optical Co.
Size Control Co.
Webber Gage Co.

GAGE BLOCKS, Surface Finish
Surface Checking Gage

GAGE GLASS ILLUMINATORS
Jerguson Gage & Valve
National Co.

GAGE TESTERS, Deadweight
American Inst. Co.
Amthor Testing Inst. Co.
Coleman Inst. & Mfg.
Crosby Steam Gage Co.
Darley Co., W. S.
Gordon Co., Claud S.
Grove Regulator
Manning, Maxwell & Moore
Mansfield & Green
Olsen Testing Machine
Precision Scientific
Refinery Supply Co.
Ruska Inst. Corp.
Trerice Co.

GAGE TESTERS, Fluid scale
Crosby Steam Gage Co.
Manning, Maxwell & Moore
Refinery Supply

GAGE TESTERS, Liquid-column
Ideal Lab. Tool
Manning, Maxwell & Moore
Meriam Inst. Co.
Miller Falls Co.
Parks Co., Harry S.
Pioneer Instrument
Refinery Supply
Trerice Co.

GAGES (See also Object of Measuring and Control)

GAGES, Absolute Pressure
Bailey Meter Co.
Bristol Co.
Brown Inst. Div.
Clapp Instrument
Cook Electric
Distillation Products
Eclipse-Pioneer Div.
Electro Products Lab.
Emery Co., A. H.
Flader Inc., Frederic
Foxboro Co.
Fredericks Co., Geo.
General Elec. Co.
Giannini & Co.
Hathaway Inst. Co.
Hays Corp.
Kollsman Inst. Div.
Manning, Maxwell & Moore
Marsh Corp.
Mason-Neilan Regulator
Meriam Inst. Co.
Moeller Instrument
Moore Products
Precision Thermometer
Scientific Inst. Co.
Skaneateles Mfg. Co.
Statham Labs.
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Trans-Sonics, Inc.
Trimount Inst. Co.
Uehling Instrument Co.
United States Gauge
Wallace & Tiernan

GAGES, Adjustable Length
Acme Industrial
Barr Instrument
DoAll Co.
Federal Products Corp.
Merz Engineering
Nilsson Gage Co.
Scherr Co., George
Sheffield Corp.
Size Control Co.
Standard Gage
Swedish Gage
Vinco Corp.
Woodworth Co.

GAGES, Air
American Chain & Cable
American Meter Co.
Bailey Meter Co.
Bastian-Blessing Co.
Block Mfg. Co.
Bristol Co.
Dwyer Mfg. Co.
Eclipse-Pioneer Div.
Electric Auto-Lite
Federal Products
Fischer & Porter
Foxboro Co.
Friez Div.
Fulton Sylphon Div.

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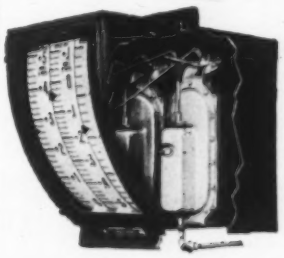


BAILEY MULTI-POINTER GAGES

● Bailey Multi-Pointer Gages are made with any number of pointers and any scale combination from one to twelve. The pointers have 10° motion over plainly marked plastic molded scales so that readings can be taken at a distance of 20 feet. Diaphragm actuated elements enable this gage to withstand over-drafts and over-pressures without injury to the unit or its calibration.

All secondary factors such as draft, pressure, temperature, stoker speed and pulverizer feed can be indicated on one Bailey Multi-Pointer Gage.

BAILEY METER COMPANY
1041 IVANHOE ROAD · CLEVELAND, O
Bailey Meter Company Ltd., Montreal, Canada

ABSOLUTE PRESSURE GAUGE

NEW MODEL 1001

Custom Calibrated—The 15" custom calibrated scale with a minimum of 100 graduations makes the dial easily readable and permits accurate interpolation.

Small Volume Required—Since the capsule is connected directly to the measured medium, a minute quantity of metered gas is required to operate the gauge.

Contamination Eliminated — The metered gas does not come in contact with the mechanism so that contamination of the gauge or system is impossible.

Accuracy—Gauge will repeat readings to one part in 500, i.e. 0.2 per cent of full scale range, and is automatically compensated for changes in atmospheric pressure. Not appreciably affected by ordinary changes in ambient temperature.

STANDARD PRESSURE RANGES

Model 1001—100 0 to 100 mm Mercury
Model 1001—200 0 to 200 mm Mercury
Model 1001—760 0 to 760 mm Mercury

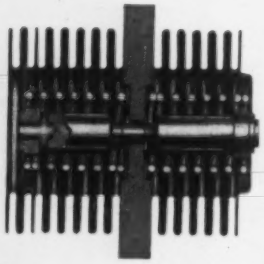
Scale can be furnished in any desired pressure equivalent.

For further details write or telephone

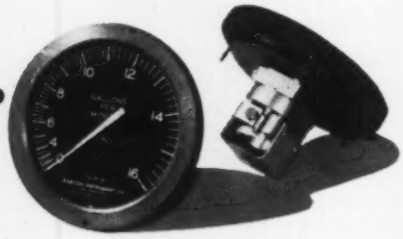
AIRPLANE & MARINE INSTRUMENTS, INC.
CLEARFIELD · PENNSYLVANIA

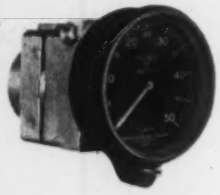
BARTON PATENTED RUPTURE-PROOF BELLOWS UNIT

for Measuring Differential Pressures, Flow and Liquid Level



This unit is the answer to trouble-free and accurate measurement of flow, liquid level and differential pressures.





Various types of recording and indicating instruments are available to suit specific requirements.

Differential ranges from 0-20 W.C. to 0-200 P.S.I. Pressure ratings up to 3000 P.S.I. Indicating instruments can be furnished with direct reading dials in a wide variety of ranges.

DETAILED INFORMATION ON REQUEST

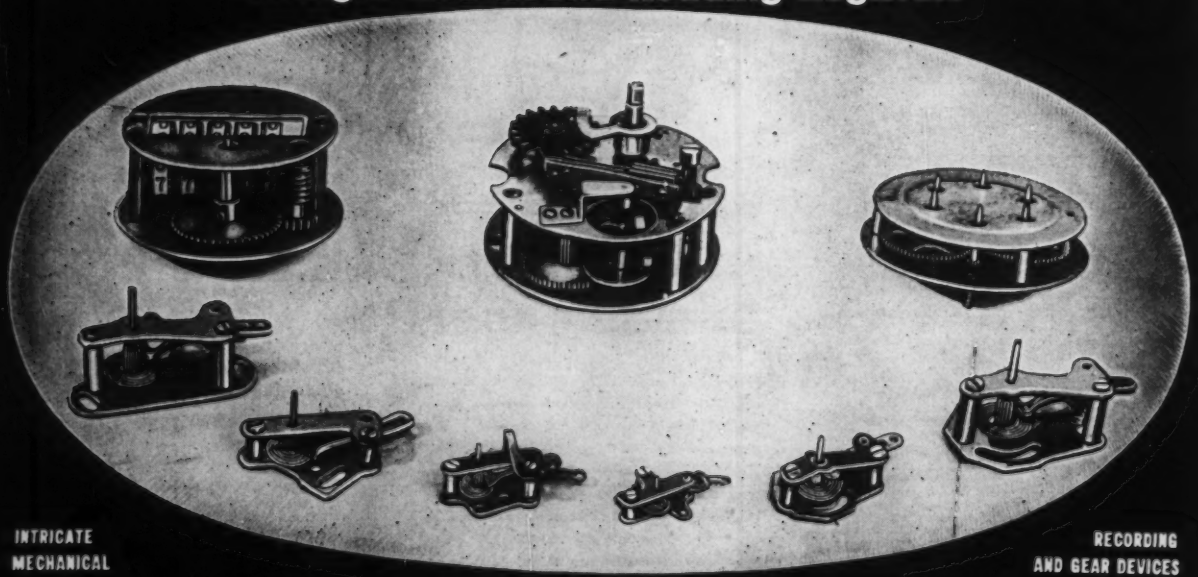
REPRESENTATIVES IN PRINCIPAL CITIES

ORIGINATORS AND MANUFACTURERS OF THE RUPTURE-PROOF BELLOWS UNIT

BARTON
INSTRUMENT COMPANY
3504 UNION PACIFIC AVE.
LOS ANGELES 23, CALIF.

PRESSURE GAUGE MOVEMENTS

Straight and Round Reading Registers



INTRICATE MECHANICAL INSTRUMENTS

RECORDING AND GEAR DEVICES OF ALL DESCRIPTIONS

D. S. PLUMB CO., INC.

73-77 Norfolk Street Newark (4), N.J.

64 YEARS SERVING THE INDUSTRY

WE MAKE THE HEART OF THE INSTRUMENT

Helicoid Gage Division

AMERICAN CHAIN & CABLE COMPANY, INC.

BRIDGEPORT 2, CONNECTICUT

ACCO

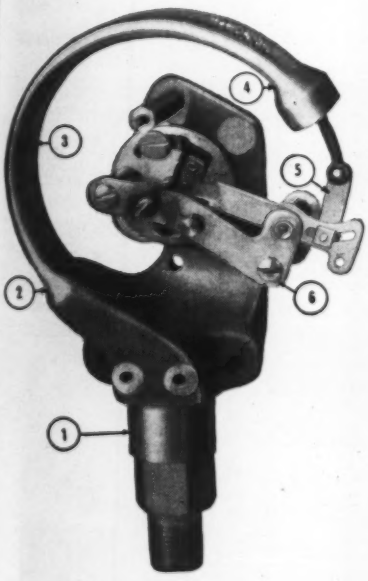
REPRESENTATIVES IN ALL PRINCIPAL CITIES . . . SEE YOUR NEAREST DISTRIBUTOR

ONLY HELICOID GAGES HAVE THE HELICOID MOVEMENT

The new ACALOY case for Helicoid gages is a high compression molded aluminum alloy. Treated by patented process to prevent corrosion. Weatherproof. Greater strength—less weight. Durable baked-on finish. Neoprene gasket. Stainless steel (18-8) snap ring. Made with a back flange for surface mounting, and without a flange for stem mounting.

Rear view of ACALOY case shows safety blow-out discs supplied when specified. The discs are Buna N, and are held by 18-8 stainless steel snap rings. The safety discs release when any pressure in the case reaches 6 p.s.i. The glass front of the gage withstands 35 p.s.i. in the 4½" dial size. Extra charge for safety blow-out discs.

Weather-proof, molded Phenol Turret Case, U. S. Navy Standard. Rugged, non-corroding, will not warp or crack, permanent, natural finish. Stainless steel (18-8) snap ring. Neoprene sealing gasket. Moisture-proof front. Supplied with bottom or back connection, for surface or stem mounting. Made in 4½", 6" and 8½" dial sizes.



THE MOST DURABLE PRESSURE GAGE SYSTEM

The illustration shows a Helicoid gage system with the KOREX steel Bourdon tube.

1. The socket is a one-piece drop forging, streamlined to eliminate a pocket at the juncture of the socket and the Bourdon tube to facilitate cleaning.

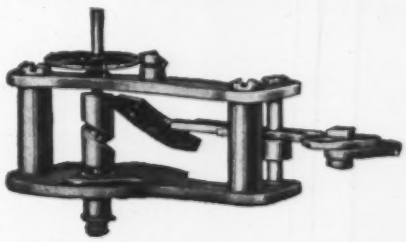
2. The forged steel socket is fused to the KOREX tube.

3. The KOREX Bourdon tube is alloy steel, stainless steel or K Monel.

4. The forged steel end piece or tip is fused to the KOREX tube. No solder, no welding rod.

5. The connecting link is stainless steel. The link screws are also stainless steel. The adjustment screw is at the rear so that the gage may be calibrated as a unit without removing the pointer or dial.

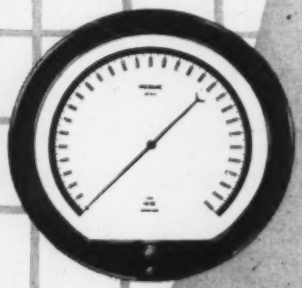
6. The Helicoid movement is either bronze with stainless steel bushings and link, or all stainless steel.



THE HELICOID MOVEMENT

In the Helicoid movement, motion is transmitted by a cam contacting the helical groove in a roller. Cam facing is polished, graphited Bakelite. Helical groove in roller is highly polished and roller rides on stainless steel, ball-shaped bearing. Hairline adjustment of pointer is made with screwdriver from back of case. Link adjusting screw is at rear so that calibration is possible without removing dial or pointer. Connecting link and screws and all bushings are stainless steel.

one-second zero setting
with revolving dial and
external knob



HEISE GAUGES

STANDARD OF THE WORLD

Zero adjustment in Heise Bourdon pressure gauges is simply a matter of turning an external knob with the fingers. No tools are needed. Nothing is removed. The knob rotates the dial until zero and pointer coincide. Direct readings of absolute pressure can be made by setting the dial to agree with barometric pressure.

Three sizes: 8½ in., 12 in., and 16 in., in ranges from 0-15 to 0-10,000 psi. Prices from $151.60 to $211.20. Write for catalog.

Heise Bourdon Tube Company, Inc.
Newtown, Connecticut

Gauthier, Donat A.
Hastings Instrument
Hays Corp.
Lambert Meter Co., Inc.
Manning, Maxwell & Moore
Marsh Corp.
Marshalltown Mfg.
Mason-Neilan Regulator
Meriam Inst. Co.
Merz Engineering
Moore Products
Parks Co., Harry S.
Pratt & Whitney
Rochester Mfg. Co.
Seely Inst. Co.
Sheffield Corp.
Statham Labs.
Taglabue Corp., C. J.
Taylor Inst. Cos.
Trerice Co.
Uehling Inst. Co.
U. S. Gauge
Weksler Thermometer
Witt Gage Co.

GAGES, Alarm

Bailey Meter Co.
Barton Inst. Co.
Bristol Co.
Brown Inst. Div.
Ellison Draft Gage Co.
Fischer & Porter
Foxboro Co.
Manning, Maxwell & Moore
Marsh Corp.
Marshalltown Mfg.
Mason-Neilan Regulator
Parks Co., Harry S.
Petrometer Corp.
Precision Therm. & Inst.
Rochester Mfg. Co.
Trerice Co.
U. S. Gauge
Weksler Thermometer
Wheelco Instruments

GAGES, Amplifying

Ames Co., B. C.
Comtor Corp.
Engineering Res. & Dev.
Federal Prod. Corp.
Merz Engineering
Poole Instruments
Pratt & Whitney
Precision Gage & Tool
Scherr Co., Inc.
Sheffield Corp.
Statham Labs.
Swedish Gage

GAGES, Automatic Sorting

Arma Corporation
DoAll Co.
Electric Eye Equip.
Electric Sorting Machine
Federal Products Corp.
Hathaway Instrument
Heyman Co.
Magnetic Gauge Co.
Martin-Hubbard Corp.

(Continued)

Merz Engineering
Pratt & Whitney
Rowe Engineering
Sheffield Corp.
Yankee Precision

GAGES, Bore

Brown & Sharpe
Commercial Research
Comtor Co.
Federal Prod. Corp.
Gauthier, Donat
Industrial Prod. Div.
Lufkin Rule Co.
Merz Engineering
Moore Products
Nilsson Gage Co.
Poole Instruments
Pratt & Whitney
Scherr Co.
Sheffield Corp.
Size Control Co.
Standard Gage
Swanson Tool Mach.
Swedish Gage
United Precision Prods.
Vinco Co.
Yankee Precision

GAGES, Bourdon

American Chain & Cable
Automatic Temp. Control
Bailey Meter Co.
Baldwin Locomotive
Bastian-Blessing Co.
Beacon Gage Co.
Belfield Co.
Bristol Co.
Brown Inst. Div.
Builders-Providence
Clapp Instrument
Crosby Steam Gage
Dickson Co.
Electric Auto-Lite
Emery Co., A. H.
Foxboro Co.
Giannini & Co., G. M.
Gordon Co., Claud S.
Gotham Inst. Co.
Hays Corp.
Heise Bourdon Tube
Hoke, Inc.
Kollsman Inst. Co.
Lonergan Co.
Manning, Maxwell & Moore
Marsh Corp.
Marshalltown Mfg.
Mason-Neilan Regulator
Mercoid Corp.
Perfex Corp.
Republic Flow Meters
Shallcross Controls
Sheffield Corp.
Taglabue Corp., C. J.
Taylor Inst. Cos.
Trerice Co.
United States Gauge
Weksler Thermometer
Welch Scientific

(Continued)

Wheelco Instruments
Witt Gage Co.

GAGES, Caliper (Dial)

Amer. Measuring Insts.
Ames Co., B. C.
Brown & Sharpe
Comtor Co.
DoAll Co.
Federal Prod. Corp.
Glogau & Co.
Marshall Co.
Nilsson Gage Co.
Sheffield Corp.
Size Control Co.
Starrett Co.
Vinco Corp.
Waltham Dial Gage

GAGES, Center

Brown Sharpe
Bryant Chucking
Lufkin Rule Co.
Miller Falls Co.
Sheffield Corp.
Size Control Co.
Starrett Co.
Union Tool Co.
Vinco Corp.

GAGES, Coating Thickness

American Inst. Co.
Ames Co., B. C.
Branson Instruments
Gardner Laboratory
General Electric Co.
Koehler Instrument

GAGES, Comparator

Amer. Measuring Insts.
Ames Co., B. C.
Menter Scope Inst.
Compar Inst. Co.
Comtor Co.
DoAll Co.
Eltzen Co.
Engineers Specialty Div.
Federal Prod. Co.
Ferner Co.
Gauthier, Donat
General Elec. Co.
General Engg. & Model
Hathaway Instrument
Johnson Gage Co.
Jones & Lamson Machine
Link Engg. & Mfg.
Merz Engineering
Metron Instrument
Moore Products
Nilsson Gage Co.
Poole Instruments
Pratt & Whitney
Precision Gage & Tool
Scherr Co.
Sheffield Corp.
Size Control Co.
Standard Gage
Surface Checking Gage
Swedish Gage
Vinco Corp
Waltham Dial Gage

(Continued)

Woodworth Co.
Yanke Precision

GAGES, Compression

Bacharach Indus. Inst.
Baldwin Locomotive
Dillon & Co.
Electric Auto-Lite
Marsh Corp.
Olsen Testing Machine
Pratt & Whitney
Precision Scientific
Riehle Div.
Statham Labs.
Toledo Scale Co.
United States Gauge
Witt Gage Co.

GAGES, Continuous Thickness

Commercial Research
DoAll Co.
Electric Eye Equip.
Federal Prod. Corp.
Foxboro Co.
Gauthier, Donat A.
Hathaway Instrument
Magnetic Gauge Co.
Merz Engineering
Poole Manufacturing
Pratt & Whitney
Schaevitz Engg.
Sheffield Corp.
Starrett Co.
Telviso Products
Vinco Corp.
Waltham Dial Gage
Yankee Precision

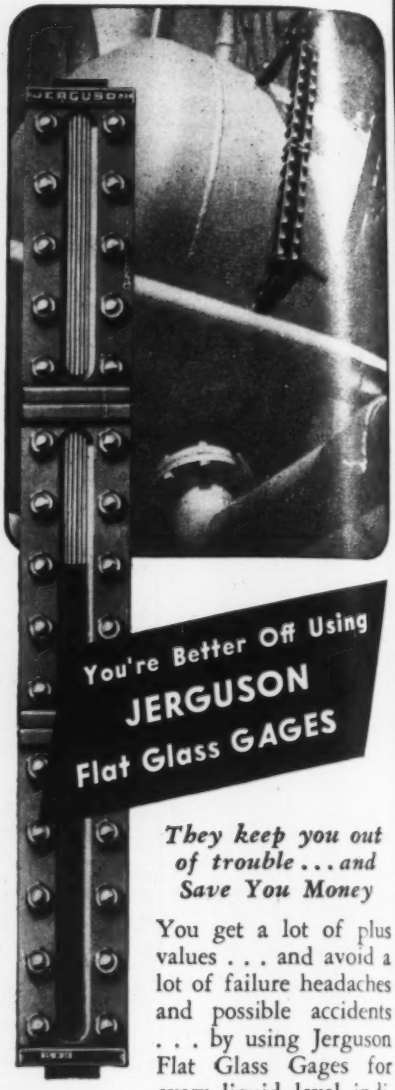
GAGES, Continuous, Width

Barr Instrument
DoAll Co.
Federal Products Corp.
Gauthier, Donat A.
Hathaway Instrument
Merz Engineering
Pratt & Whitney
Sheffield Corp.
Vinco Corp.
Yankee Precision

GAGES, Contour see Gage, Profile

GAGES, Cylinder

American Gage Co.
Ames Co., B. C.
Brown & Sharpe
Comtor Co.
Dearborn Gage Co.
Elgin National Watch
Federal Prod. Corp.
Lufkin Rule Co.
Merz Engineering
Nilsson Gage Co.
Poole Instruments
Pratt & Whitney
Rimat Machine
Sheffield Corp.
Size Control Div.
Standard Gage
Starrett Co.
Swedish Gage
United Precision Products



You're Better Off Using
JERGUSON
Flat Glass GAGES

Jerguson Reflex Gage

They keep you out of trouble . . . and Save You Money

You get a lot of plus values . . . and avoid a lot of failure headaches and possible accidents . . . by using Jerguson Flat Glass Gages for every liquid level indicating use.

You get the kind of gages and valves you want to do YOUR JOB. Jerguson offers you the most complete line available. Jerguson offers you an engineering organization specializing in building special gages to meet problems.

Jerguson Flat Glass Gages save money and labor. They are easy to install. They stand up . . . you don't have to keep servicing them or replacing the glass. They are available in a wide range of sizes, pressures, designs and materials; also with polished end stems to replace present tubular gages.

Write us about your problems or requirements.

JERGUSON
GAGE & VALVE COMPANY
100 Fellsway, Somerville 45, Mass.
Representatives in Major Cities
Phone Listed Under JERGUSON

NOW IT'S HERE...*the New "VAREC" Electronic Gauger!*

COSTS YOU LESS

Initial costs are lower because the new electronic design eliminates Selsyn Motors. Installation costs are less because fewer and smaller wires are used.

GIVES YOU GREATER ACCURACY

Accuracy is only limited by types of float gauge used. Measures liquid level to ± 1/16" with "VAREC" 253 Series Automatic Tank Gauges. Not affected by wide line voltage variations.

PROMOTES SAFETY

No climbing on slippery tanks during wet or icy weather. No danger from toxic vapors. Low voltage, low current transmitter completely isolated from tank vapors.

EASY TO OPERATE AND MAINTAIN

You need only select the tank to obtain an accurate continuous gauge reading. You need only push a button to instantaneously check receiver adjustments. It is not necessary to reset instrument after power failure.

GREATER VERSATILITY

Transmitters may be installed on tanks already equipped with suitable float-type gauges. Small, compact receiver may be located on desk or panel mounted. Readings may be made at more than one remote position by installing additional receivers. High-low level alarms or controls may be added to the receiver without running additional wires to the tanks.

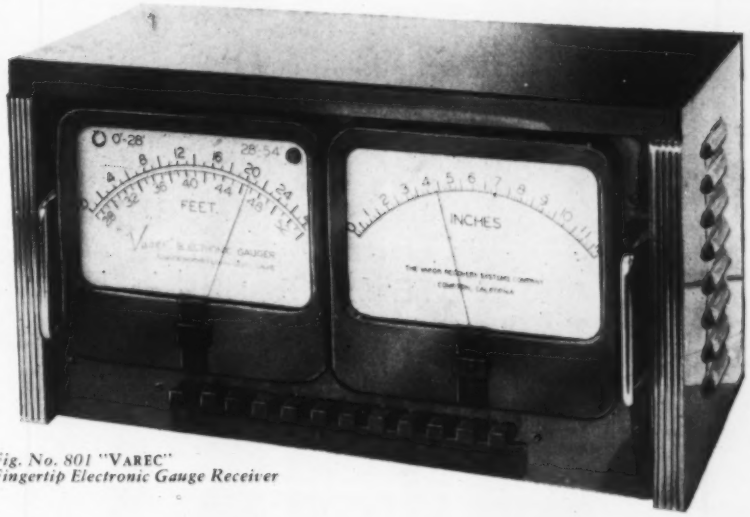


Fig. No. 801 "VAREC" Fingertip Electronic Gauge Receiver

REMOTE LIQUID LEVEL GAUGING AT ITS BEST!

Now you can gauge your tanks accurately to within ± 1/16" of tank level on a centrally located panel. The new "VAREC" Electronic Gauges enable you to duplicate tank gauge readings at any location... gives you greater accuracy when installed with "VAREC" Automatic Tank Gauges. Eliminates traveling throughout the tank farm or gauging tanks outside during bad weather. Eliminates the dangers of toxic vapors. Eliminates the errors from the human element in gauging.

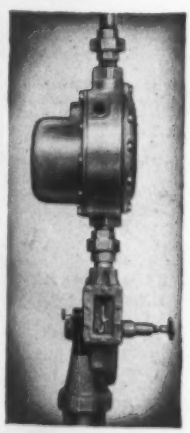
MULTIPLE OR SINGLE TANK RECEIVERS

Multiple Tank Receivers, for individual gauging up to 10 tanks or up to 24 tanks; On-Gauge Receivers for individual tanks or simultaneous gauging. The front panel of each receiver has two dials. Feet indications from 0 to 54 feet are read on the left-hand dial and inch indications from 0 to 12 inches by 1/8" increments are read on the right-hand dial. Proper reading of the foot scale is designated by two colored pilot lights at the upper corners of the dial. The receivers are designed for use on 110-115 volt, 50-60 cycle, a-c power.

EXPLOSION-PROOF TRANSMITTERS

Transmitters are available in four designs to meet tank working pressure requirements. All are designed to be explosion-proof, suitable for use in Class 1, Group D, hazardous locations.

Fig. No. 850 Electronic Gauger Transmitter installed above lookbox of "VAREC" Fig. No. 253 Automatic Tank Gauge.



PROVED and APPROVED "Varec"

THE VAPOR RECOVERY SYSTEMS COMPANY
NEW YORK PITTSBURGH CHICAGO TULSA HOUSTON
COMPTON, CALIFORNIA, U.S.A.

DEPT: II

NAME_____ TITLE_____

STREET and No._____

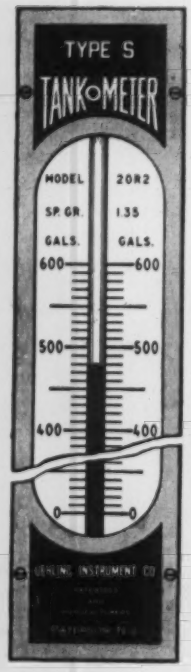
CITY and STATE_____

Send for Your Copy of "Remote Gauging at Its Best" Today!

SEE THE "VAREC" ELECTRONIC GAUGER AT THE I.S.A. INSTRUMENT EXHIBIT IN ST. LOUIS SEPTEMBER 12-16

UEHLING INSTRUMENT CO.

PATERSON 3, NEW JERSEY



INSTRUMENTS FOR MEASURING

PRESSURE-VACUUM-DRAFT
DIFFERENTIAL PRESSURE
BAROMETRIC PRESSURE
ABSOLUTE PRESSURE
TANK CONTENTS
DEPTH & FLOW

MEASURE AND KNOW

SEND FOR BULLETINS

Size Control Co.
Standard Gage
Starrett Co.
Swedish Gage Co.
Vinco Corp.
Waltham Dial Gage

GAGES, Differential Pressure
American Meter Co.
Bacharach Industrial Inst.
Bailey Meter Co.
Barton Inst. Co.
Beacon Gage Co.
Bristol Co.
Brown Inst. Div.
Builders-Providence
Cleveland Fuel Equip.
Crosby Steam Gage
Defender Automatic Reg.
Dwyer Mfg. Co.
Ellison Draft Gage Co.
Electro Products Lab.
Emery Co., A. H.
Engineering Res. & Dev.
Flader, Inc., Fredric
Foxboro Co.
Friez Instrument
Gas Appliance Specialities
Gauthier, Donat A.
General Elec. Co.
Hathaway Inst. Co.
Hays Corp.
Kollsman Inst. Div.
Leupold & Stevens
Manning, Maxwell & Moore
Marsh Corp.
Mason-Neilan Regulator
Meriam Instrument
Metron Instrument
Moeller Instrument
Moore Products Co.
Parks Co., Harry S.
Perfex Corp.
Phoenix Precision Inst.
Pioneer Instrument
Pitometer Log Corp.
Precision Scientific
Precision Therm.
Preferred Utilities Mfg.
Republic Flow Meters
Schaevitz Engg.
Scientific Glass Apparatus
Scientific Inst. Co.
Sheffield Corp.
Simplex Valve & Meter
Statham Labs.
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Thermo Instruments
Trerice Co., H. O.
Trimount Instrument
Uehling Instrument Co.
U. S. Gauge
Weksler Thermometer
Witt Gage Co.

GAGES, Draft (See Gages, Differential Pressure)

GAGES, Drill Grinding
Brown & Sharpe

(Continued)

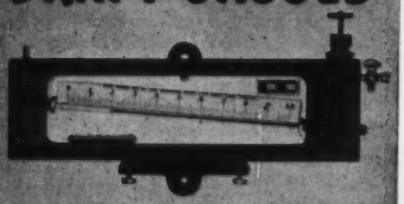
Dearborn Gage
Lufkin Rule
Starrett Co.
United Precision Parts

GAGES, Feeler
Acme Industrial
American Meas. Insts.
Barker Tool Div.
Brown & Sharpe
Dearborn Gage
Elgin National Watch
Lufkin Rule Co.
Millers Falls Co.
Size Control Co.
Starrett Co.
Swedish Gage
Union Tool Co.
Van Keuren Co.
Vinco Corp.

GAGES, Flush Pin
Acme Industrial
Allen Gauge & Tool Co.
American Gage Co.
Amer. Measuring Insts.
Barker Tool Div.
Cadillac Gage Co.
Dearborn Gage Co.
Elgin National Watch
Federal Products Corp.
Fonda Gage Co.
Jansson Gage Co.
Lawrence & Hill
Lincoln Park Industries
Lufkin Rule Co.
Merz Engineering
Nilsson Gage Co.
Sheffield Corp.
Size Control Co.
Swedish Gage
United Precision Prods.
Vinco Corp.
Woodworth Co.
West & Dodge Thread
Yankee Precision

GAGES, Gas
American Meter Co.
Bailey Meter Co.
Bastion-Blessing
Bristol Co.
Connelly Co.
Dickson Co.
Foxboro Co.
Gas Appliance Specialities
General Elec. Co.
Hays Corp.
Linde Air Products
Manning, Maxwell & Moore
Mason-Neilan Regulator
Marsh Corp.
Meriam Instrument
Parks Co., Harry S.
Republic Flow Meters
Rochester Mfg. Co.
Specialty Glass Co.
Statham Labs.
Superior Meter Co.
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Uehling Instrument
Witt Gage Co.

DRAFT GAUGES



• These are extremely serviceable direct reading instruments for measuring low pressures, drafts and differentials—built with inclined tubes to give increased scale length and permit the taking of readings in fractional inches of water. Each instrument individually calibrated to assure extremely accurate operation. Oil or mercury filled tubes. Also two-tube and three-tube models for taking multiple readings with the same gauge. Fully descriptive catalog sent on request.

THE MERIAM INSTRUMENT CO.
10938 MADISON AVENUE
CLEVELAND 2, OHIO
Manometers, Meters, and Gauges for the accurate measurement of Pressures, Vacuums and Flows of Liquids and Gases.

GAGES, Dead Weight
American Instrument
Ames Co., B. C.
Coleman Inst. & Mfg.
Eastern Specialty
Gordon Co., Claud S.
Grove Regulator
Link Engineering
Manning, Maxwell & Moore
Mansfield & Green
Marshalltown Mfg.
Parks Co., Harry S.
Ruska Inst. Corp.
Swedish Gage Co.

GAGES, Depth, Linear
Amer. Measuring Insts.
Ames Co., B. C.
Brown & Sharpe
Carson Micrometer
DoAll Co.
Federal Products Corp.
General Elec. Co.
Glogau & Co.
Jansson Gage Co.
Lincoln Park Tool & Gage
Lufkin Rule Co.
Merz Engineering
Millers Falls
Park Sales
Petrometer Corp.
Pratt & Whitney
R & M Mfg. Co.
Ryan Tool & Engg.
Shand & Jurs Co.
Sheffield Corp.
Size Control Co.
Standard Gage
Starrett Co.
Swedish Gage
Union Tool Co.
Vinco Corp.
Waltham Dial Gage

GAGES, Depth, Navigational
Geophysical Inst. Co.
G. M. Mfg. Co.
Kahl Sci. Inst.
King Engineering Corp.
Negus, T. S. & J. D.
Parks Co., Harry S.
U. S. Gauge

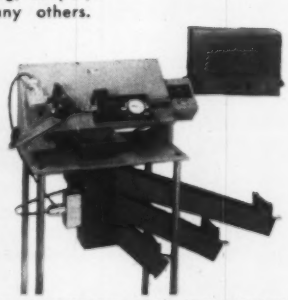
GAGES, Dial, Machinists'
American Meas. Insts.
Ames Co., B. C.
Brown & Sharpe
Chicago Dial Ind.
DoAll Co.
Eltzen Co.
Federal Prod. Corp.
Ferner Co.
Genales, Andrew
General Engg. & Model
Micro Master Co.
Nilsson Gage Co.
Sheffield Corp.

(Continued)

FEDERAL
INDICATING GAGES

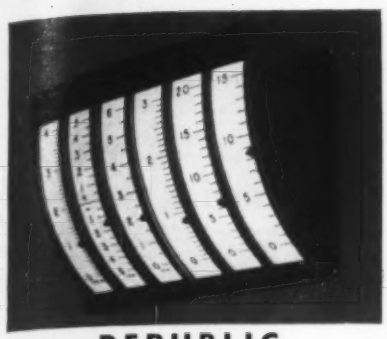
Regular and Special DIAL INDICATOR GAGES
All types for controlling dimensions: snap, hole, thickness, grinding, caliper, comparator, depth and many others.

Dimensional Air Gages
Simplest to install and operate, foolproof and extremely accurate. Adaptable.



ELECTRONIC AND AUTOMATIC SORTING GAGES — made to suit requirements.

Send for Catalog —
FEDERAL PRODUCTS CORPORATION
1142 EDDY STREET • PROVIDENCE 1, R. I.



REPUBLIC DRAFT GAGES

Republic multi-point indicators are supplied for all ranges of draft, pressure and differentials encountered in furnace operation in any desired combination.

Indicating units are interchangeable and are operated by a dry-bellows type of diaphragm. The 12-inch vertical, translucent scales are illuminated from the rear. All adjustments are made from the front of the panel and each unit may be withdrawn without disturbing others.

WRITE FOR DATA BOOK No. 802

REPUBLIC FLOW METERS CO.
2240 Diversey Pkwy. Chicago 47, Ill.

REPUBLIC INSTRUMENTS • CONTROLS

MARSH Pressure Gauges

Mastergauge —

Marsh quality, stamina and accuracy, is found in its highest development in the "Masterguage". Accuracy is guaranteed within ½ of 1% of reading. Advanced monel and stainless steel movement and rugged bourdon tube assure *lasting* accuracy under all conditions. Try the Masterguage where others have failed. There is one for every service.

"Recalibrator"—describes Marsh method of correcting a gauge that has been knocked out of adjustment. Quickest and best means ever devised. Available in all Marsh Gauges.

Standard Gauge

A moderately priced gauge which represents remarkable value. Wide range of types—pressure; compound; vacuum.

JAS. P. MARSH CORPORATION
Dept. 8, Skokie, Illinois

GAGES, Grinding
Acme Industrial
American Meas. Insts.
Ames Co., B. C.
Barker Tool Die
Brown & Sharpe
Comtor Co.
Dearborn Gage Co.
Elgin National Watch
Federal Prod. Corp.
Lufkin Rule Co.
Master Gauge
Merz Engineering
Moore Products
Nilsson Gage Co.
Sheffield Corp.
Size Control Co.
Swedish Gage Co.
United Precision Prods.

GAGES, Grinding Finish
General Electric Co.
Surface Checking Gage

GAGES, Height
Allen Gauge & Tool Co.
Amer Measuring Insts.
Ashton Valve Co.
Barker Tool Die
Barr Instrument
Brown & Sharpe
DoAll Co.
Federal Products Corp.
General Engg. & Model
Jansson Gage Co.
Lufkin Rule Co.
Merz Engineering
Park Sales Co.
Pratt & Whitney
Ryan Tool & Engg.
Scherr Co.
Sheffield Corp.
Size Control Co.
Standard Gage
Starrett Co.
Swedish Gage Co.
Vineo Corp.

GAGES, Hook
Dwyer Mfg. Co.
Friez Instruments
Gurley, W. & L. E.
Leupold & Stevens
Lufkin Rule Co.
Scientific Inst. (Calif.)
Swedish Gage Co.
White Co., Inc.

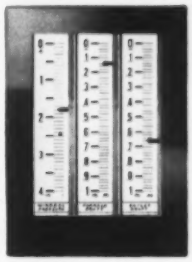
GAGES, Hydrostatic
(See Gages, Liquid Level, Indicating)

GAGES, Internal Dial
Ames Co., B. C.
Byrant Chucking Grinder
Comtor Co.
DoAll Co.
Federal Products Corp.
Gn. Engg. & Model Wks.
Merz Engineering
Nilsson Mfg. Co.
Scherr Co.
Sheffield Corp.
Size Control Co.
Standard Gage
swedish Gage
Vineo Corp.

GAGES, Limit
Acme Industrial
Amer Measuring Insts.
Barker Tool Die
Brown & Sharpe
Dearborn Gage Co.
Detroit Tap & Tool
Federal Products Corp.
Fonda Gage
General Elec. Co.
Greenfield Tap & Die
Jansson Gage Co.
Metron Instrument
Merz Engineering
M-G Gauge Corp.
Pratt & Whitney
Sheffield Corp.
Size Control Co.
Standard Gage
Swedish Gage
Van Keuren Co.
Vineo Corp.
West & Dodge
Woodworth Co.
Yankee Precision

GAGES, Liquid Level Indicating
American Meter Co.
Autocall Co.
Automatic Control Co.
Automatic Temp. Control
Bacharach Industrial Inst.
Bailey Meter Co.
Barton Inst. Co.
Bastian-Blessing
Belfield Co.
Bin-Dicator Co.
Boston Auto Gage
Bowser & Co.
Bristol Co.
Brown Inst. Co.
Builders-Providence
Bunnell Co., J. H.
B. W. Controller
Canadian Radium
Clapp Instrument
Climax Engineering
Control Corp.
Cook Electric
Crosby Steam Gage
Davis Reg. Co.
Defender Automatic Reg.
Dickson Co.
Dwyer Mfg. Co.
Eclipse-Pioneer Div.
Electric Auto-Lite
Elec. Indicator Corp.
Electric Tachometer Corp.
Elematic Equip. Co.
Electronic Prod. Co.
Engineering Research Ass.
Esterline-Angus
Fischer & Porter
Fisher Governor Co.
(Continued)

A Full Line of Ellison Gages for every Combustion Control Problem



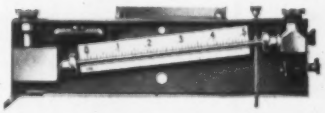
STRAIGHT LINE Pointer Draft Gages

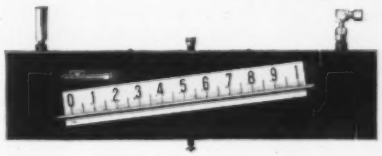
Diafram type, stationary and marine use. A high power free floating pure silk diafram with a travel of .25 to .75, a displacement 8.4 to 17.5 cubic inches at 1" pressure. Write for Bulletin 24-B. Bell type, stationary use, 2½" travel—write for Bulletin No. 22. Translucent glass scales and labels.

Inclined Draft Gages

PORTABLE

Portable Draft Gages are of outstanding design and accuracy. Stamping of Monel—reading minus, plus or differential. Level and Tube replaced in field. Write for Bulletin 9-F

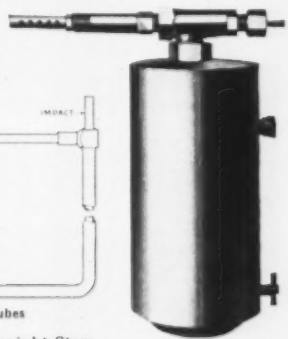


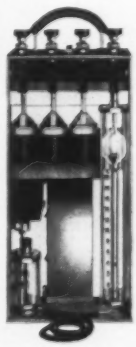


STATIONARY

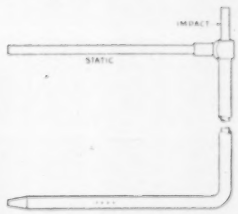
Ellison Inclined Gages with upward inclined tube. No oil in tube over scale at zero, .2" oil head, constant zero with wide room temperature changes. Level and Tube replaced in field. Write for Bulletin 9-F.

Combustion Testing Set available with necessary equipment for the analysis for C02, 02 and CO— complete with flue Gas Thermometer. Write for Bulletin 20-F.





PORTABLE GAS ANALYZER



Pitot Tubes

Angle and Straight Stem Type, for air and gas flow measurements. Conical and hemispherical tip, brass, for temperatures up to 500° f. Stainless steel, temperatures up to 1,000° f. Write for Bulletin 9-F.

U PATH STEAM CALORIMETER

U Path Steam Calorimeters. Combines a Throttling separating and re-evaporating Calorimeter in a single chamber. Write for Bulletin 8-B

ELLISON DRAFT GAGE CO.

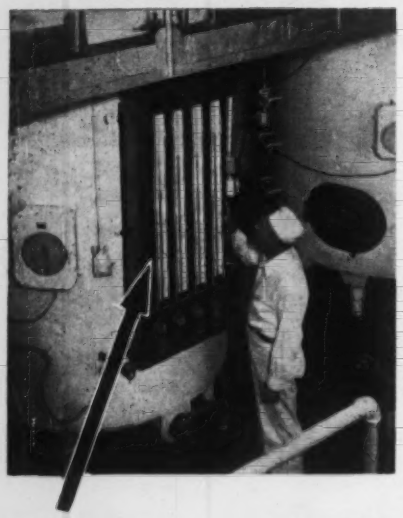
Since 1896

214 West Kinzie St., Chicago 10, Illinois

The Ellison Line also includes:
Dial Draft Gages—Bell Type • Inclined-Vertical Tube Gages
Vertical Tube Gages—Oil, Heavy Liquid, Mercury—Single & Multi-Tube
Saturator Gages • U Gages—Stationary and Portable
Air Filter Gages—Dial and Inclined Tube types

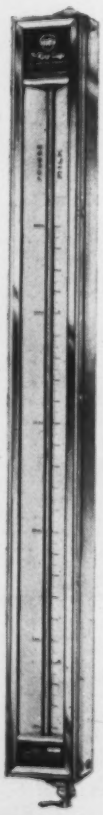
ELLISON INSTRUMENTS—Outstanding Design, Construction and Accuracy

The King-Gage



WEIGH the LIQUIDS *In Your Tanks!*

AT A FRACTION OF WEIGH-TANK COST



- King-Gages are now measuring nearly every kind of liquid in storage or process tanks.
- The Scale, graduated in pounds or gallons, checks accurately the receipts, inventory and movement of liquids in your plant.
- King-Gages save time and make blending more accurate by measuring fluids directly into mixing tanks.
- They measure paint, resins, thinners, oils, latex, tar, acid, gasoline, syrup, milk, alcohol, water and numerous other liquids.
- Safely measure hazardous liquids that should be kept from contact with air.
- Installation & Service Departments in 15 leading cities.
- For further information write for Bulletin G-101 or explain liquid measuring problem.

KING ENGINEERING CORP.
BOX 70
ANN ARBOR, MICHIGAN

Foxboro Co.
Frick Co.
Friez Instrument Div.
General Controls Co.
General Elec. Co.
Gorrell & Gorrell
Gotham Inst. Co.
Gray Instrument
Guardian Electric
Gurley, W. & L. E.
Hammel-Dahl Co.
Hathaway Inst. Co.
Hays Corp.
Instrument Lab., Inc.
Jerguson Gage Co.
Johnston & Jennings
Keckley Mfg. Co.
Kellogg Switchboard
King Engineering
Klingerit, Inc.
Leeds & Northrup Co.
Leupold & Stevens
Liquidometer Co.
Lufkin Rule Co.
Lumenite Elec. Co.
Magnetrol, Inc.
Manning, Maxwell & Moore
Marsh Corp.
Marshalltown Mfg.
Mason-Neilan Regulator
McAlear Mfg.
McNeill Engineering
Meriam Instrument
Minneapolis-Honeywell
Moore Products
Nathan Mfg. Co.
Natural Gas Equipment
Paragon Electric
Parks Co., Harry S.
Penberthy Injector Co.
Photoswitch, Inc.
Pitometer Log Corp.
Pneumercator Co., Inc.
Positel Mfg. Co.
Precision Therm.
Peferred Utilities Mfg.
Reliance Gauge Column
Republic Flow Meters
Rochester Mfg. Co.
Rosen Engg. Prods.
Schutte & Koerting Co.
Shand & Jurs Co.
Simmonds Aerocessories
Simplex Valve & Mter
Smith Meter Co.
Statham Labs.
Tagliabue Corp. C. J.
Taylor Inst. Cos.
Thermo Instruments
Trerice Co.
Trimount Instrument
U C Indicator Sales
Uehling Instrument Co.
U. S. Gauge
Vapor Recovery Systems
Viking Instruments
Wallace & Tiernan
Weksler Thermometer
Warrick Co.
Westinghouse Elec. & Mfg.
Wheelco Inst. Co.
Williams Gauge Co.
Watt Gage Co.
Yarnall-Waing Co.

GAGES, Liquid Level, Recording (See Gages, Liquid Level, Indicating)
Bailey Meter Co.
Barton Inst. Co.
Bristol Co.
Builders-Providence
Foxboro Co.
Infilco, Inc.
International Filter Co.
Parks Co., Harry S.
Republic Flow Meters
Simplex Valve & Meter
Taylor Inst. Cos.
Uehling Inst. Co.

GAGES, Mercury
Amthor Testing Mach.
Bacharach Industrial Inst.
Bailey Meter Co.
Barton Inst. Co.
Builders-Providence
Central Scientific
Connelly Co.
Distillation Products
Dwyer Mfg. Co.
Electronic Products
Ellison Draft Gage
Gas Appliance Specialities
General Elec. Co.
Hays Corp.
Heise Bourdon Tube
Ideal Lab. Tool
King Engineering
Machlett & Son
Manning, Maxwell & Moore
Mason-Neilan Regulator
Meriam Instrument
Moeller Instrument
Parks Co., Harry S.
Precision Therm.
Refinery Supply Co.
Scientific Glass Apparatus
Scientific Instrument
Simplex Valve & Meter
Specialty Glass Co.
Stoetling Co., C. H.
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Trerice Co.
Trimount Instrument
Uehling Instrument Co.
U. S. Gauge Co.
Universal X-Ray Prods.
Wallace Scientific
Westinghouse Elec.

GAGES, Micrometer
American Meter Co.
Ames Co., B. C.
Amthor Testing Mach.
Axelson Mfg.
Brown & Sharpe
Cadillac Gage Co.
Central Scientific Co.

(Continued)

Eitzen Co.
Elgin National Watch
Federal Products Corp.
Gaertner Scientific Corp.
Gauthier, Donat A.
Instrument Dev. Labs.
Lufkin Rule Co.
Miller Falls Co.
Pratt & Whitney
Precision Therm. & Inst.
Rimat Machine
Scherr Co.
Sheffield Corp.
Slocomb Co.
Starrett Co.
Swedish Gage
Van Keuren Co.
Vinco Corp.
Wilmotte, Inc.
Zeiss, Inc., Carl

GAGES, Oil (See Gages, Liquid Level)

GAGES, Optical
Acme Industrial
Amer. Measuring Insts.
Bausch & Lomb
Buchele, W.
Clark & Sons
DoAll Co.
Engineers Specialty Div.
Fecker, Inc.
Gaertner Scientific Corp.
Instrument Dev. Labs.
Jarrell-Ash Co.
Jones & Lamson Machine
Palos Optical Co.
Perkin-Elmer Corp.
Phoenix Prec. Inst.
Ruska & Co.
Scherr Co.
Sheffield Corp.
Vinco Corp.
Zeiss, Inc., Carl

GAGES, Paint Film
American Inst. Co.
Ames Co., B. C.
Branson Instruments
Carson Micrometer
Gardner Laboratory
General Elec. Co.
Hathaway Inst. Co.
Metron Instrument
Munsell Color Co.

GAGES, Paper Thickness (See Gages, Thickness)

GAGES, Piston Ring
Amer. Measuring Insts.
Brown & Sharpe
Circle Gage Co.
Elgin National Watch
Federal Products Corp.
Link Engineering
Merz Engineering
Sheffield Corp.
Swedish Gage
Wilkening Mfg. Co.

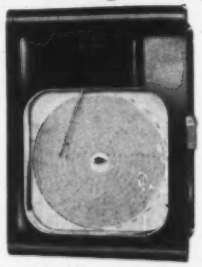
GAGES, Pitch Diameter
Acme Industrial
Brown & Sharpe
Bryant Chucking Grinder
Detroit Tap & Tool
DoAll Co.
Federal Prod. Corp.
Fonda Gage Co.
Greenfield Tap & Die
Lufkin Rule Co.
Merz Engineering
Pratt & Whitney
Scherr Co., Inc.
Sheffild Corp.
Size Control Co.
Starrett Co.
Swedish Gage Co.
Union Tool Co.
Van Keuren Co.
Vinco Corp.
West & Dodge Thread
Woodworth Co.
Yankee Precision

GAGES, Plug
Acme Industrial
American Gauge Co.
Amer. Measuring Insts.
Barker Tool Die
Brown & Sharpe
Cadillac Gage Co.
Corning Glass Works
Dearborn Gage Co.
Detroit Tap & Tool
DoAll Co.
Eitzen Co.
Elgin National Watch
Federal Products, Corp.
Fonda Gage
Greenfield Tap & Die
Lawrence & Hill
Lincoln Park Industries
Merz Engineering
Nilsson Gage Co.
Park Sales Co.
Pratt & Whitney
Precision Gage & Tool
R & M Mfg. Co.
Sheffield Corp.
Size Control Co.
Standard Gage
Swedish Gage
United Precision Prod.
Vinco Corp.
West & Dodge Thr. Gage
Woodworth Co.
Yankee Precision

GAGES, Pneumatic Tank
Bacharach Industrial
Barton Inst. Co.
Foxboro Co.
Gauthier, Donat A.
Liquidometer Corp.
Marsh Corp.
Mason-Neilan Regulator
Parks Co., Harry S.
Pneumercator Co.
Rochester Co.
Uehling Inst. Co.
U. S. Gauge Co.

NEW

BRISTOL SERIES 500 Recording and Controlling Gauges

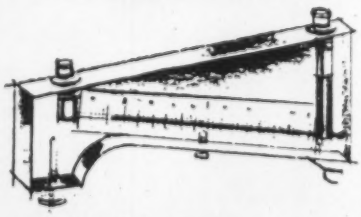


Bristol Series 500 Gauges are offered in a wide variety of models for recording and controlling pressure, draft, vacuum, absolute pressure, liquid level.
These instruments are highly accurate, dependable, rugged and extremely stable in all ranges of application. They include many design improvements and refinements that make them easier to use, more convenient to service, readily convertible from one type to another and simpler in construction. In addition, the new case offers maximum protection for the working elements and a modern design in harmony with the latest industrial trends.
Wall and panel mounting; also portable. Ranges from full vacuum to 12,000 psi. Single, double or three-pen models.

Write for Bulletin T835.

THE BRISTOL COMPANY
113 BRISTOL ROAD, WATERBURY 91, CONN.

MEASURE DRAFTS AIR VELOCITIES and SLIGHT PRESSURE CHANGES with
DWYER TRANSPARENT INCLINED TUBE GAGES



- Highly Accurate
- Easy To Operate
- Unbreakable Plastic Body
- Always-Visible Scale, .01" Graduations
- Micrometer Adjusting Screw

Write for DWYER Bulletin 205

F. W. Dwyer Mfg. Co.
305 South Western Ave. Chicago 12, Illinois

GAGES, Precision Measuring

Acme Industrial
Ames Co., B. C.
Amer. Measuring Inst.
Arma Corporation
Barr Instrument
Brown & Sharpe
Bryant Chucking Grinder
Cadillac Gage Co.
Carson Micrometer
Comtor Co.
Dearborn Gage Co.
DeAll Co.
Eitzen Co.
ElginNational Watch
Federal Prod. Corp.
Ferner Co.
Fonda Gage Co.
Gauthier, Donat A.
General Elec. Co.
Graham-Mintel Inst.
Jansson Gage Co.
Lufkin Rule Co.
Magnetic Gauge Co.
Martin-Hubbard Corp.
Merz Engineering
Metron Instrument
Moore Products
Nilsson Gage Co.
Phoenix Prec. Inst.
Physicists Research
Poole Instruments
Pratt & Whitney
Rieker Instrument Co.
Scherr Co., Inc.
Sheffield Corp.
Size Control Co.
Standard Gage
Starrett Co.
Swedish Gage
Thwing-Albert Inst. Co.
United Precision Prod.
Van Keuren Co.
Vinco Corp.
Webber Gage Co.
Wilmotte, Inc.
Woodworth Co.
Carl Zeiss, Inc.

GAGES, Pressure, Indicating

Aeroquip Corp.
American Chain & Cable
American Meter Co.
Bacharach Industrial Ints.
Bailey Meter Co.
Baird Meter Co.
Baird Associates
Baldwin Locomotive
Bastian-Blessing
Beacon Gage Co.
Belfield Co.
Block Mfg. Co.
Boekel & Co.
Bristol Co.
Brown Inst. Div.
Bryant Chucking Grinder
Brush Development Co.
Builders-Providence
Central Scientific Co.
Clapp Instrument
Clark Blast Meter
Cleveland Fuel Equip.
Coleman Inst. & Mfg.
Commerical Research
Consol. Ashcroft Hancock
Consolidated Engg.
Continental Elec. Co.
Crosby Steam Gage
Dayton-Rogers Mfg. Co.
Defender Automatic Reg.
DeJuhasz, K. J.
Dickson Co.
Dillon & Co.
Distillation Products
Dwyer Mfg. Co.
Eclipse-Pioneer Div.
Electric Auto-Lite
Electro Products Labs.
Electronic Products Co.
Elematic Equip. Corp.
Ellison Draft Gage
Emery Co., A. H.
Esterline-Angus Co.
Fisher Scientific Co.
Foxboro Co.
Fredericks Co., George
Friez Instrument
Fulton Syphon Div.
Gas Appliance Specialties
General Elec. Co.
General Physical Lab.
Giannini & Co.
(Continued)

Gordon Co., Claud S.
Gotham Inst.
Hathaway Inst. Co.
Hays Corp.
Heise Bourdon Tube
H & H Thermostats
Kollsman Inst. Div.
Logansport Machine
Lonergan Co.
Magnetic Gauge Co.
Manning, Maxwell & Moore
Mansfield & Green
Marsh Corp.
Marshalltown Mfg. Co.
Mason-Neilan Regulator
Massa Laboratories
Mercoid Corp.
Meriam Instrument
Metron Instrument
Moeller Instrument Co.
Moore Products
National Research
Nurnberg Thermometer
Parks Co., Harry S.
Perfex Corp.
Physicists Research
Precision Gage & Tool
Precision Therm.
Preferred Utilities Mfg.
Process & Instruments
RCA Div.
Refinery Supply Co.
Republic Flow Meters
Rochester Mfg. Co.
Scientific Glass App.
Scientific Inst. Co.
Seely Inst. Co., Inc.
Sheffield Corp.
Skaneateles Mfg. Co.
Statham Labs.
Stewart-Warner Corp.
Stoelting Co., C. H.
Stokes Machine Co.
Superior Meter Co.
Surface Combustion
Sylvania Elec. Prod.
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Thwing-Albert Inst. Co.
Trans-Sonics, Inc.
Trerice Co.
Trimount Instrument
Tuthill Instrument Co.
U. S. Gauge
Universal X-Ray Prods.
Wagner & Son, Carl H.
Wallace & Tiernan (Low Pressure)
Weksler Thermometer
Welch Scientific
Wheelco Instruments
Wilgus Manufacturing
Winslow Co.
Witt Gage Co.

GAGES, Pressure—Recording (See Gages, Pressure, Indicating)

GAGES, Pressure Temperature (See Gages, Pressure Indicating

GAGES, Pressure & Vacuum (See Gages, Pressure Indicating)

GAGES, Profile

Acme Industrial
American Gage Co.
Amer. Measuring Insts.
Barker Tool Die
Brush Devlopment
Cadillac Gage Co.
Dearborn Gage Co.
Engineers Specialty Div.
Federal Products Corp.
Fonda Gage
Foxboro Co.
General Elec. Co.
Jansson Gage Co.
Jeuckes Knitting Mach.
Lincoln Park Industries
Martin-Hubbard Corp.
Merz Engineering
Nilsson Gage Co.
Physicists Research
Pratt & Whitney
Precision Gage & Tool
Sheffield Corp.
Size Control Div.
Swedish Gage Co.
United Precision Prods.
Vinco Corp.
Woodworth Co.
Yankee Precision

GAGES, Radius

Acme Industrial
American Meas. Insts.
Barker Tool Die
Brown & Sharpe
Cadillac Gage Co.
Dearborn Gage Co.
Federal Products Corp.
Fonda Gage Co.
Lufkin Rule Co.
Nilsson Gage Co.
Sheffield Corp.
Size Control Co.
Starrett Co.
Swedish Gage Co.
United Precision Prods.
Vinco Corp.
Wilmotte, Inc.
Woodworth Co.

GAGES, Rain (See Rain Gages)

GAGES, Rifle Bore

Baldwin Locomotive
Federal Products Corp.
Fonda Gage Co.
Gauthier, Donat A.
Hathaway Inst. Co.
Moore Products
Nilsson Gage Co.
Poole Instruments
Pratt & Whitney
Sheffield Corp.
Vinco Corp.

GAGES, Ring

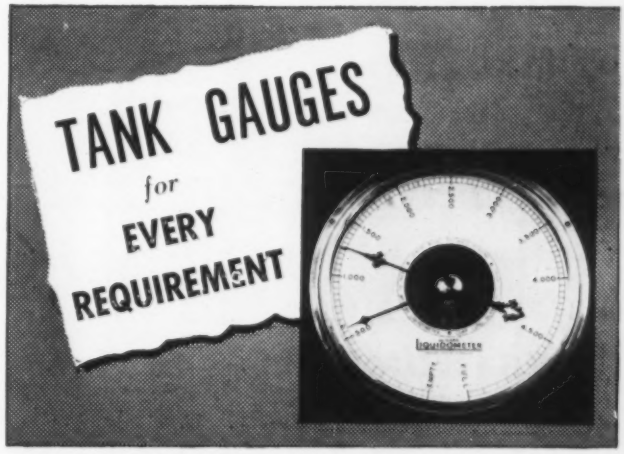
Acme Industrial
Allen Gauge & Tool Co.
American Gage Co.
Amer. Measuring Insts.
Barker Tool Die
Brown & Sharpe
Bryant Chucking
Cadillac Gage Co.
Corning Glass Works
Dearborn Gage Co.
Detroit Tap & Tool
Elgin National Watch
Gauthier, Donat A.
Greenfield Tap & Die
Johnson Gage Co.
Lawrence & Hill
Lincoln Park Industries
Merz Engineering
Nilsson Gage Co.
Park Sales Co.
Pratt & Whitney
Precision Gage & Tool
Sheffield Corp.
Size Control Co.
Standard Gage
Swedish Gage Co.
United Precision Prods.
Vinco Corp.
West & Dodge Thread
Woodworth Co.
Worley Jewel Co.
Yankee Precision
Zeiss, Inc., Carl

GAGES, Screw Thread

Acme Industrial
Allen Gauge & Tool Co.
Brown & Sharpe
Bryant Chucking
Cadillac Gage Co.
Detroit Tap & Tool
Federal Prod. Corp.
Fonda Gage Co.
Greenfield Tap & Die
Jansson Gage Co.
Johnson Gage Co.
Lincoln Park Industries
Lufkin Rule Co.
Merz Engineering
Millers Falls Co.
Pratt & Whitney
Sheffield Corp.
Size Control Co.
Starrett Co.
Swedish Gage Co.
Union Tool Co.
Vinco Corp.
West & Dodge Thread
Woodworth Co.
Zeiss, Inc., Carl

GAGES, Sliding

Acme Industrial
Amer. Measuring Insts.
Barr Instrument
Lufkin Rule Co.
Pratt & Whitney
Size Control Co.
Van Keuren Co.



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GAGES, Snap

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Allen Gauge & Tool Co.
American Gage Co.
American Measuring Insts.
Barker Tool Die
Barr Instrument
Brown & Sharpe
Cadillac Gage Co.
Dearborn Gage Co.
Detroit Tap & Tool
Federal Products Corp.
Fonda Gage Co.
Gauthier, Donat A.
Gen. Engg. & Model Wks.
Greenfield Tap & Die
Jansson Gage Co.
Johnson Gage Co.
Lawrence & Hill
Merz Engineering
Metzger & Son
M-G Gage Corp.
Nilsson Gage Co.
Pratt & Whitney
Precision Gage & Tool
Scherr Co.
Sheffield Corp.
Size Control Co.
Standard Gage
Swedish Gage Co.
United Precision Prods.
Vinco Corp.

GAGES, Spline

Acme Industrial
(Continued)

American Meas. Insts.
Brown & Sharpe
Federal Products Corp.
Merz Engineering
Pratt & Whitney
Precision Gage & Tool
Sheffield Corp.
Size Control Co.
Standard Gage
Vinco Corp.

GAGES, Star

Federal Products Corp.
Gauthier, Donat A.
Moore Products
Pratt & Whitney
Sheffield Corp.
Yankee Precision

GAGES, Strain

Acme Industrial
American Inst. Co.
Anderson, Arthur R.
Bailey Meter Co.
Baldwin Locomotive
Dillon & Co.
Edin Electronics
Eitzen Co.
Electronic Products Co.
Federal Products Corp.
Gauthier, Donat A.
General Elec. Co.
Giannini & Co.
Hathaway Inst. Co.
Hays Corp.
Heiland Research
Metzer & Son
Miller Corp., Wm.
Olsen Testing Machine
Pratt & Whitney
Riehle Testing Mach.
Starrett Co.
Statham Labs.

GAGES, Surface

Acme Industrial
American Meas. Insts.
Ames Co., B. C.
Barr Instrument
Blake Co., Edward
Brown & Sharpe
Brush Development
Comtor Co.
Dearborn Gage Co.
Edin Electronics
Federal Products Corp.
Genales, Andrew
Jansson Gage Co.
Lufkin Rule Co.
Millers Falls Co.
Optron Laboratory
Palos Optical Co.
Physicists Research
Precision Scientific
Standard Gage
Starrett Co.
Swedish Gage
(Continued)

Vinco Corp.
Yankee Precision
Zeiss, Inc., Carl

GAGES, Surface Finish Checking

Blake Co., Edward
Link Eng. & Mfg.
Physicists Research
Surface Checking Gage

GAGES, Taper

Acme Industrial
American Gage Co.
Barker Tool Die
Brown & Sharpe
Cadillac Gage Co.
Dearborn Gage Co.
Elgin National Watch
Federal Prod. Corp.
Fonda Gage Co.
Gauthier, Donat A.
General Electric
Greenfield Tap & Die
Lincoln Park Tool
Merz Engineering
Micro Master Co.
Moore Products
Nilsson Gage Co.
Poole Instruments
Precision Gage & Tool
Pratt & Whitney
Sheffield Corp.
Size Control Co.
Standard Gage
Starrett Co.
Swedish Gage
United Precision Prod.
Vinco Corp.
Woodworth Co.
Yankee Precision

GAGES, Telescoping

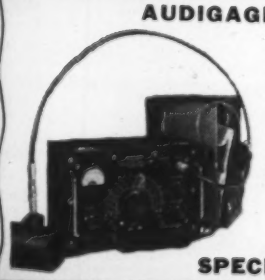
Brown & Sharpe
Federal Products Corp.
Lufkin Rule Co.
Starrett Co.
Swedish Gage Co.

GAGES, Thickness

American Inst. Co.
Ames Co., B. C.
Amthor Testing Inst. Co.
Automatic Temp. Control
Barker Tool Die
Branson Instruments
Brown & Sharpe
Canadian Radium
Carson Micrometer
Commercial Research
Edin Electronics
Elgin National Watch
Dearborn Gage Co.
Federal Prod. Corp.
Fonda Gage Co.
Gauthier, Donat A.
Glogan & Co.
Gen. Engg. & Model Wks.
(Continued)

NON-DESTRUCTIVE THICKNESS GAGES

AUDIGAGE



For Testing Metal Thickness From One Side

Range: 1/16"-12.0"

COATINGAGE

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Range: 0.0001"—0.5"

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LABORATORY

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Metzger & Son
Millers Falls Co.
Moore Products
Photocon Research
Poole Instruments
Pratt & Whitney
Precision Gage & Tool
Precision Scientific Co.
Precision Therm. & Inst.
Scott Testers
Sheffield Corp.
Size Control Co.
Speidel & Co.
Sperry Products, Inc.
Standard Gage
Starrett Co.
Swedish Gage
Thwing-Albert Inst. Co.
Union Tool Co.
United Precision Prods.
Van Keuren Co.
Vinco Corp.
Waltham Dial Gage
Westinghouse Elec.
Woodworth Co.
Yankee Precision

GAGES, Thickness, Magnetic
American Inst. Co.
Commercial Research
Electric Eye Equip.
General Elec. Co.
Hathaway Inst. Co.
Hickok Elec. Inst. Co.
Metron Instrument
Pratt & Whitney
Schaevitz Engg.
Sheffield Corp.

GAGES, Thread
Acme Industrial
Bryant Checking
Fonda Gage
Johnson Gage Co.
Pratt & Whitney
Sheffield Corp.
Size Control Co.
Swedish Gage Co.

GAGES, Torque
Airdraulics Engineering
General Elec. Co.
Hagan Corp.
Hathaway Inst. Co.
Manning, Maxwell & Moore
Martin Decker Corp.
Metron Instrument
Pelouze Mfg. Co.
Riehle Div.
Schaevitz Engg.
Statham Labs.
Sturtevant Co.
Toledo Scale Co.

GAGES, Vacuum (See Gages, Pressure)

GAGES, Venturi (See Flow Meters, Venturi)

GAGES, Water Level (See GAGES, Liquid Level)

GAGES, Wind
American Inst. Co.
Bacharach Ind. Inst.
Electric Speed Ind.
Friez Inst. Div.
Green, Henry J.
Hastings Inst. Co.
Illinois Testing Labs.
Instruments Corp.
Kenyon Inst. Co.
Rieker Inst. Co.
Stewart, M. C.
Taylor Inst. Cos.
Thomas Co., Arthur H.

GAGES, Wire Measuring
Amer. Measuring Insts.
Ames Co., B. C.
Brown & Sharpe
Elgin National Watch
Federal Prod. Corp.
Foxboro Co.
General Elec. Co.
Greenfield Tap & Die
Hathaway Inst. Co.
Merz Engineering
Moore Products
Nilsson Gage Co.
Pratt & Whitney
Sheffield Corp.
Starrett Co.
Swedish Gage Co.
United Precision Prods.

GAGING FIXTURES
Acme Industrial
Amer. Measuring Insts.
Allen Gauge & Tool Co.
Barker Tool Die
Dearborn Gauge Co.
Eitzen Co.
Electric Eye Equip.
Elgin National Watch
Federal Products Corp.
Fonda Gage Co.
Jansson Gage
Lawrence & Hill
Lincoln Park Industries
Link Engineering
Merz Engineering
Ryan Tool & Engg.
Size Control Co.
Stocker & Yale
Swanson Tool Mach. Prod.
Swedish Gage
Vinco Corp.
Waltham D 1 Gage
Wilmotte, Inc.
Woodworth Co.

GALVANOMETERS, A-c
Associated Research
Brush Development Co.
Cambridge Inst. Co.
Central Scientific Co.
Century Geophysical
Cole Instruments
Consolidated Engg.
Dale Instruments
Edin Electronics
General Elec. Co.
General Radio Co.
Gilman Scientific
G. M. Laboratories
Hathaway Inst. Co.
Heiland Research Corp.
Hickok Elec. Inst.
Leeds & Northrup Co.
Metron Instrument
Pfaltz & Bauer, Inc.
Rawson Electrical Inst.
RCA Manufacturing
Roller-Smith Co.
Rubicon Co.
Sensitive Research Inst.
Tagliabue Corp., C. J.
Welch Mfg. Co.
Weston Elec. Inst.
Wheelco Inst. Co.

GALVANOMETERS, Astatic
Cambridge Inst. Co.
Central Scientific Co.
Chicago Apparatus Co.
Cole Instrument
Dale Instruments
Hathaway Inst. Co.
Leeds & Northrup Co.
Rawson Electrical Inst.
Ruska Instrument
Sensitive Research Inst.
Welch Scientific
Westinghouse Elec.
Wheelco Inst. Co.

GALVANOMETERS, D-c
Assembly Products
Associated Research
Brown Inst. Div.
Brush Development Co.
Cambridge Inst. Co.
Central Scientific Co.
Century Geophysical
Cole Instrument
Coleman Inst. & Mfg.
Consolidated Engg.
Dale Instruments
DeJur-Amsco
Edin Electronics
Edison Elec. Controls
Electric Des. & Eng.
Electronic Development
General Electric
Gilman Scientific
G-M Labs.
Hathaway Inst. Co.
Heiland Research
Hickok Elec. Inst.
Jarrell-Ash Co.
J-B-T Instrument Co.
Leeds & Northrup Co.
Marion Electric Inst.
M B Instruments
Meters, Inc.
Metron Instrument
Rawson Electrical Inst.
RCA Manufacturing Co.
Roller-Smith Co.
Rubicon Co.
Sanborn Co.
Sensitive Research Inst.
Shallcross Mfg. Co.
Simpson Elec. Co.
Southwestern Ind. Elec.
Taco West Corp.
Tagliabue Corp., C. J.
Thwing-Albert Inst.
Triplett Electrical Inst.
Welch Scientific
Westinghouse Elec.
Weston Elec. Inst. Corp.
Wheelco Inst. Co.
Winslow Co.

GALVANOMETERS Piezoelectric
Brush Development Co.

GALVANOMETERS, Reflecting
Associated Research
Brush Development
Century Geophysical
Cole Instrument
Coleman Instrument
Consolidated Engg.
General Electric Co.
G-M Laboratories
Hathaway Inst. Co.
Heiland Research
Jarrell-Ash Co.
Leeds & Northrup
Pfaltz & Bauer
Rawson Electrical Inst.
Rubicon Co.
Ruska & Co.
Sanborn Co.
Southwestern Ind. Elec.
Sprengnether Inst. Co.
Thwing-Albert Inst. Co.

GALVANOMETERS, Vacuum-tube
Cole Instrument
Electronic Div. Lab.
Electro Products Lab.
Engineering Labs., Inc.
General Radio
Harvey Radio Labs.
Hathaway Instrument Co.
Heiland Research
MacDonald Co., W. S.
Measurements Corp.
National Technical Labs.
RCA Manufacturing
Sanborn Co.
Tagliabue Corp., C. J.
Varo Mfg. Co.

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BRISTOL
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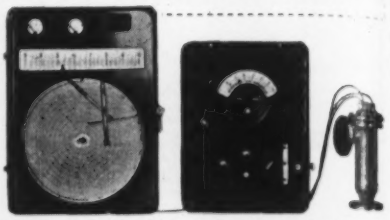

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Consolidated Engg.
Hathaway Inst. Co.
Leeds & Northrup

GALVANOSCOPES
Central Scientific Co.
Stoelting Co., C. H.
Welch Scientific

GAS ANALYZERS, Air
Aloe Co., A. S.
Burrell Technical Supply
Cambridge Inst. Co.
Central Scientific Co.
Cook Electric
Davis Emergency Equip.
Fish-Schurman Co.
Fisher Scientific Co.
Friez Div.
General Elec. Co.
Hays Corp.
Hebler Co.
Mercoid Corp.
Mine Safety Appliances
Perkin-Elmer Corp.
Permutit Co.
Process & Instruments
Refinery Supply Co.
Sargent & Co.
Scientific Glass App.
Tagliabue Corp., C. J.
Wilson Products, Inc.

GAS ANALYZERS, Ammonia
Baird Associates
Burrell Technical Supply
Cambridge Inst.
Davis Emergency Equip.
Engelhard, Chas.
General Elec. Co.
Hays Corp.
Hebler Co.
Mercoid Corp.
Perkin-Elmer Corp.
Permutit Co.
Process & Instruments
Sargent & Co.
Tagliabue Corp., C. J.

GAS ANALYZERS, Carbon Dioxide
Ace Glass, Inc.
Bacharach Industrial Inst.
Baird Associates
Brown Inst. Div.
Burrell Tech. Supply
Cambridge Inst. Co.
Central Scientific Co.
Davis Emergency Equip.
Defender Inst. & Reg.
Dwyer Mfg. Co.
Ellison Draft Gage Co.
Engelhard, Chas.
Fish-Schurman Co.
Fisher Scientific

(Continued)

Friez Instrument
General Electric Co.
Gordon Co., Claud S.
Gow-Mac Instrument
Hays Corp.
Hebler Co.
Laboratory Equip. Co.
Leeds & Northrup Co.
Machlett & Son
Mine Safety Appliances
Perkin Elmer Corp.
Permutit Co.
Potter Co.
Precision Therm.
Preferred Utilities Mfg.
Process & Instruments
Refinery Supply Co.
Republic Flow Meters
Sargent & Co.
Scientific Glass App.
Scientific Inst. Co.
Uehling Instrument Co.
Viking Instruments
Williams Apparatus Co.

GAS ANALYZERS, Carbon Monoxide
Bacharach Industrial Inst.
Bailey Meter Co.
Baird Associates
Burrell Technical Supply
Cambridge Inst. Co.
Central Scientific
Chicago Apparatus Co.
Davis Emergency Equip.
Eclipse Aviation
Electric Heat Control
Fish-Schurman Co.
Fisher Scientific
General Elec. Co.
Hays Corp.
Laboratory Equip. Co.
Leeds & Northrup Co.
Machlett & Son
Mine Safety Appliances
Perkin-Elmer Corp.
Sargent & Co.
Scientific Glass App.
Scientific Inst. Co.
Taller & Cooper
Will Corporation

GAS ANALYZERS, Chlorinated Hydrocarbons
Baird Associates
Consolidated Engg.
Davis Emergency Equip.
Engelhard, Chas.
General Elec. Co.
Hebler Co.
Industrial Insts. Inc.
Mine Safety Appliances
National Tech. Labs.
Perkin-Elmer Corp.
Precision Scientific
Wilson Products, Inc.

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GAS ANALYZERS, Flue Gas (See Gas Analyzers, Carbon Dioxide or Oxygen)

GAS ANALYZERS, Hydrocarbon
Applied Physics Corp.
Bailey Meter Co.
Baird Associates
Burrell Tech. Sup.
Consolidated Eng.
Davis Emergency Equip.
Distillation Products, Inc.
Engelhard, Chas.
Fisher Scientific
General Elec. Co.
Hebler Co.
Industrial Insts. Inc.
Johnson-Williams, Ltd.
Mine Safty Appliances
National Tech. Labs.
Perkin-Elmer Corp.
Precision Scientific

GAS ANALYZERS, Hydrogen
Bacharach Industrial Inst.
Burrell Technical Supply
Chicago Apparatus Co.
Davis Emergency Equip.
Engelhard, Chas.
Fisher Scientific
Genral Elec. Co.
Gow-Mac Inst. Co.
Hays Corp.
Hebler Co.
Johnson-Williams, Ltd.
Leeds & Northrup
Mine Safety Appliances
Permutit Co.

GAS ANALYZERS, Hydrogen Sulphide
American Meter
Baird Associates
Burrell Technical Supply
Cambridge Inst. Co.
Connelly Co.
Consolidated Engg.
Davis Emergency Equip.
Engelhard, Chas.
Fisher Scientific
Hebler Co.
Industrial Inst. Inc.
Johnson-Williams, Ltd.
Mine Safety Appliance
Perkin-Elmer Corp.
Rubicon Co.
Sargent & Co.
Scientific Glass Apparatus

GAS ANALYZERS, Nitric Oxide
Baird Associates
Cambridge Inst. Co.
Davis Emergency Equip.
Engelhard, Chas.
Fisher Scientific
General Electric Co.
Hays Corp.
Mine Safety Appliances
Perkin-Elmer Corp.
Rubicon Co.
Sargent & Co.

GAS ANALYZERS, Orsat
Ace Glass, Inc.
Bacharach Ind. Inst.
Bailey Meter Co.

(Continued)

Burrell Technical Supply
Central Scientific Co.
Chicago Apparatus Co.
Defender Automatic Reg.
Dwyer Mfg. Co.
Ellison Draft Gage
Fish-Schurman Co.
Fisher Scientific Co.
Hays Corp.
Howe & French, Inc.
Laboratory Equip. Co.
Machlett & Son
Precision Therm.
Sargent & Co.
Scientific Glass App.
Specialty Glass Co.
Thomas Co., Arthur H.

GAS ANALYZERS, Oxygen
Bacharach Industrial Inst.
Bailey Meter Co.
Burrell Technical Supply
Chicago Apparatus Co.
Cambridge Inst. Co.
Davis Emergency Equip.
Eclipse Aviation
Hays Corp.
Hebler Co.
Johnson-Williams, Ltd.
Laboratory Equip. Corp.
Leeds & Northrup
Mine Safety Appliances
National Tech. Labs.
Precision Scientific
Process & Instruments
Sargent & Co.
Scientific Glass App.
Superior Meter Co.
Tagliabue Corp., C. J.

GAS ANALYZERS, Oxygen & Nitrogen Apparatus
Bailey Meter Co.
Boekel & Co.
Burrell Technical Supply
Cambridge Inst. Co.
Central Scientific Co.
Davis Emergency Equip.
Fisher Scientific
Hays Corp.
Hebler Co.
Laboratory Equip. Co.
Leeds & Northrup
Mine Safety App. Co.
Precision Scientific
Process & Instruments
Sargent & Co.
Scientific Glass App.
Tagliabue Corp., C. J.

GAS ANALYZERS, Sulphur Dioxide
Bacharach Industrial Inst.
Baird Associates
Burrell Tech. Sup.
Cambridge Inst. Co.
Davis Emergency Equip.
Engelhard, Chas.
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Hays Corp.
Hebler Co.
Laboratory Equip. Co.
Leeds & Northrup Co.
Perkin-Elmer Corp.
Precision Scientific
Sargent & Co.
Scientific Glass App.
Skaneateles Mfg. Co.
Uehling Instrument Co.

GAS APPARATUS, Orifice Well Tester
Refinery Supply Co.

GAS DENSITY METERS
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Central Scientific Co.
Ess Inst. Co.
Foxboro Co.
Hagan Corp.
Permutit Co.
Precision Therm.
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Thomas Co., Arthur H.

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Askania Regulator Co.
Bacharach Industrial Inst.
Bailey Meter Co.
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Brooks Rotameter
Brown Inst. Div.
Builders-Providence
Commercial Research
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Statham Labs.
Taylor Inst. Cos.

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Bristol Co.
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Elec. Tachometer Corp.
Foxboro Co.
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Zubr, Inc., Henry

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Bullard Co.
Consolidated Engg.
Darley Co., W. S.
Davis Emergency Equip.
Distillation Products
Fischer & Porter
Fisher Res. Lab.
Foxboro Co.
General Elec. Co.
Gilmore, E. R.
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Goldak Co.
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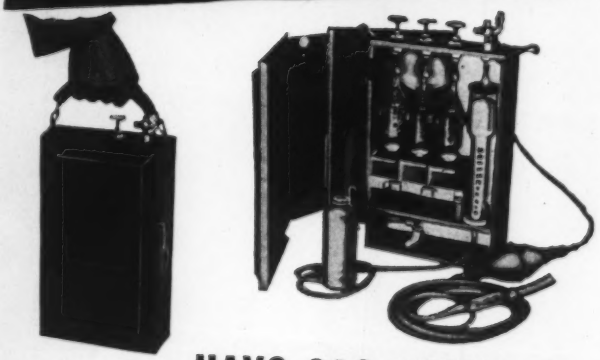

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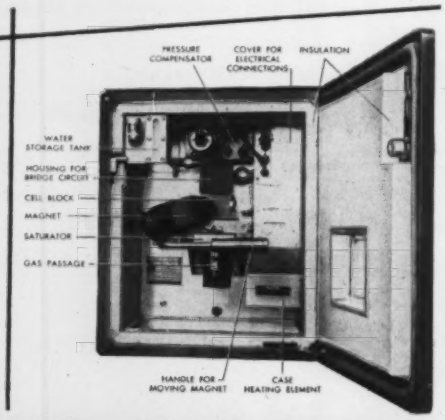

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GAS METERS, INFERENTIAL—Venturi (See Flowmeters, Venturi)

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Gen. Elec. Co.
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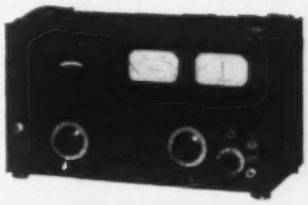

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Simpson Optical Mfg.
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Porter, George K.
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Instrument Dev. Labs.
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GOVERNORS, District
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Hammel-Dahl Co.

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General Controls
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GOVERNORS, Hydraulic
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McAlear Mfg. Co.
Schade Valve Mfg.
Taglia.Je Corp., C. J.

GOVERNORS, Liquid Level (See Controllers, Automatic, Liquid Level)

GOVERNORS, Pressure (See Regulators, Automatic, Air)
GOVERNORS, Pump (See Regulators, Automatic, Air)
GOVERNORS, Station
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Fisher Governor
GOVERNORS, Steam (Regulators, Automatic, Air)
GOVERNORS, Turbine
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Askania Regulator Co.
Cash Co.
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GRAIN TESTERS (See Testers, Grain)
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HYDROMETERS, Thermo (See Hydrometers, Indicating

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Brown Inst. Div.
Ess Instrument
Foxboro Co.
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Taylor Inst. Co.
Trerice Co., H. O.

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Bristol Co.
Brown Inst. Div.
Cambridge Inst. Co.
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Foxboro Co.
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Glogau & Co.
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Hiergesell & Sons
Huddleston, J. S. F.
Illinois Testing Labs.
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Johnson Service Co.
Kahl Sci. Inst. Co.
Mason-Neilan Regulator
Moeller Instrument Co.
Palmer Thermometer
Phila. Thermometer Co.
Precision Thermometer
Riecker Inst. Co.
Sargent & Co.
Scientific Inst. Co.
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Standard Thermometer
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Trerice Co.
Wagner & Son
Wallace & Tiernan
Weksler Thermometer
Wilder Sales Co.

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Brown Inst. Div.
Cambridge Inst. Co.
Foxboro Co.
Friez Instrument Div.
General Elec. Co.
Gotham Instrument
Green, Henry J.
Instruments Corp.
Leeds & Northrup Co.
Manning, Maxwell & Moore
Mason-Neilan Regulator
Moeller Instrument Co.
Palmer Thermometer
Scientific Inst. Co.
Seedburo Equip. Co.
Serdex Inc.
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Trerice Co., H. O.
Weksler Thermometer

HYGROSTATS
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Barber-Colman Co.
Central Scientific Co.
Friez Instrument Div.
Johnson Service Co.
Powers Regulator Co.
Taylor Instrument Cos.

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Central Scientific Co.
Foxboro Co.
Friez Instruments
Green, Henry J.
Instruments Corp.
Manning, Maxwell & Moore
Serdex, Inc.
Taylor Inst. Cos.

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Kahl Sci. Inst. Co.
Keuffel & Esser Co.
Lufkin Rule Co.
Warren-Knight Co.

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Manning, Maxwell & Moore
Serdex, Inc.

IGNITION VELOCITY METERS
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Betts & Betts
Electronic Lab.
Electronic Prods. Co.
General Electric Co.
General Radio
G-M Labs.
Paragon Electric Co.
Photoswitch, Inc.
Robinette Co.
Superior Electric
Weston Elec., Inst. Corp.

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De-Jur-Amsco Corp.
General Elec. Co.
G-M Labs.
Leeds & Northrup Co.

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Meters Inc
Photovolt Corp.
Triplett Elec. Inst.
Weston Elec. Inst. Corp.

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Alfax Paper & Eng.
Brush Development
Electro-Tech Equip. Co.
Esterline-Angus Co.
General Elec. Co.

ILLUMINOMETERS, Macbeth
Leeds & Northrup

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Cargille, R. P.
Instrument Dev. Labs.
Michrochemical Service
Sheffield Corp.

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Alfax Paper & Engg.
Analysis Sales Co.
Baldwin Locomotive
Brush Development
Gorrell & Gorrell
Hathaway Inst. Co.
Impact Register
Thwing-Albert Inst. Co.

IMPACT TESTING MACHINES (See Testers & Testing Machine Impact)

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Moeller Inst. Co.
Phoenix Prec. Inst.
Precision Thermometer
Ricker Instrument
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Ferner Co.
Fischer & Porter
Fish-Schurman Co.
Kollsman Inst. Co.
Machlett & Son
Meriam Instrument
Rieker Inst. Co.
Precision Therm.
Ruehfel Co.
Schwein Engineering
Starrett Co.
Summers Gyroscope
Tejax Eng. Corp.
Trimount Inst. Co.
Warren-Knight Co.

INCLINOMETERS, Bore Hole
Sperry-Sun Well Surveying

INCLINOMETERS, Lateral (Aviation)
Eclipse-Pioneer Div.
Machlett & Son
Rieker Instrument
Schwien Engineering

INCLINOMETERS, Ship
Manning, Maxwell & Moore
Moeller Inst. Co.
Negus, T. S. & J. D.
Rieker Instrument

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pH RECORDERS

RESEARCH MODEL—For applications where utmost precision in pH measurements or titrations is essential. Reads directly in .01 pH units and in millivolts. Sturdy glass electrode of condenser type is supplied; micro glass electrode (.4 cc.) can also be furnished. Size 8½"x10"x17"; weight 25 lbs. Sensitivity .005 pH, readings reproducible to .01 pH, overall accuracy .02 pH. Range 0 to 14 pH, 0 to 1200 mv.

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Send for Literature

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Century Geophysical
Electro Products Labs.
Engineering Res. & Dev.
Photocon Research
Rowe Engineering
Sperry Gyroscope
Trimount Inst. Co.

INDICATORS, DIRECTION (Radioactuated)
Collins Radio Co.
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Kollsman Instrument
Lear, Inc.
Polarad Electronics
RCA Div.
Schwien Engg. Co.
Servo Corp. of America

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Bendix Marine Products
Cambridge Inst. Co.
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Lewis Engineering
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Trimount Inst. Co.

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Baldwin Locomotive
Cambridge Inst. Co.
Commercial Research
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Electro Products Labs.
Instrument Lab. Inc.
Marsh Corp.
Photocon Research
RCA Manufacturing
Trimount Inst. Co.
Witt Gage Co.

INDICATORS, Ignition Lag
American Instrument

INDICATORS, Multiple Recording
Alden Products
Alfax Paper & Engg.
Commercial Research

(Continued)

Eclipse-Pioneer Div.
Hays Corp.
Leeds & Northrup
Taylor Instrument Co.
Thwing-Albert Inst. Co.

INDICATORS, Rate of Climb
Automatic Temp. Control
Eclipse-Pioneer Div.
Kollsman Inst. Div.
Mason-Neilan Co.
Rieker Inst. Co.
Summers Gyroscope

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Amperite Corp.
Audio Tone Oscillator
Clough-Brengle Co.
Daven Co.
General Elec. Co.
General Radio
Polarad Electronics
RCA Manufacturing

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Boonton Radio Corp.
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Freed Transformer
General Elec. Co.
General Radio
Industrial Instruments
Leeds & Northrup Co.
Premier Crystal Labs.
Rubicon Co.
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Sickles Co.

INSPECTION, Glass & Quartz, see Immersion Liquids

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Electric Eye Equip.
Electric Sorting Mach. Co.
Gardner Laboratory
Instrument Dev. Labs.
Yankee Precision

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Do-All Co.
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Martin-Hubbard Corp.
Moore Products
Pratt & Whitney
Sheffield Corp.
Size Control Co.
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Martin-Hubbard Corp.
Moore Products
Photoswitch, Inc.
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Heyman Co.
Martin-Hubbard Corp.
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Gauthier, Donat A.
Martin-Hubbard Corp.
Metron Instrument
Moore Products
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Pratt & Whitney
Sheffield Corp.
Size Control Co.
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Yankee Precision

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Communications Meas. Lab.
Do-All Co.
Electric Eye Equip.
Electronic Dev. Lab.
Electro Products Lab.
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Photoswitch, Inc.
Poole Instruments
Size Control Co.
Sperry Products
Thordarson Elec. Mfg.
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Wilmotte, Inc.

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Brabender Corp.
Detroit Testing Mach.
General Electric
DoAll Co.
Gogan Machine
Olsen Testing Machine
Rowe Engineering
Swedish Gage Co.

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Comtor Co.
Federal Products Corp.

INSPECTION DEVICES, AUTOMATIC, Smoothness
Brush Development
Compar Inst. Co.
Comtor Co.
DoAll Co.
Electric Eye Equip.
Electronic Prod. Co.
Federal Products Corp.
Photoswitch, Inc.
Physicists Research Co.
Sheffield Corp.
Swedish Gage Co.
Thwing-Albert Inst. Co.

INSPECTION DEVICES, AUTOMATIC, Thickness
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DoAll Co.
Electric Eye Equip.
Electronic Prod. Co.
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Gaertner Scientific Corp.
Gauthier, Donat A.
General Electric Co.
Hathaway Instrument
Instrument Dev. Labs.
Magnaflux Corp.
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Moore Products
Nuclear Inst. & Chem.
Photocon Research
Photoswitch, Inc.
Rowe Engineering
Sheffield Corp.
Thwing-Albert Inst. Co.
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Rubicon Co.
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INSPECTION EQUIPMENT, Bore Hole (See Telescopes, Bore, Inspection)

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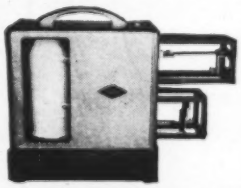

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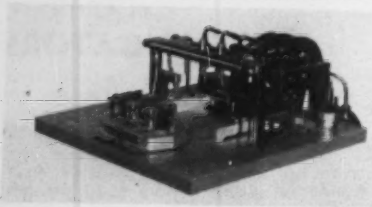

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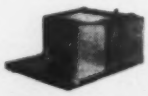

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Perkin Elmer Corp.
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LABORATORY FURNITURE (See Furniture, Laboratory)

LABORATORY GLASSWARE (See Apparatus, Laboratory, Glass)

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Ruehfel Co.
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Trerice Co.
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Zuhr, Inc., Henry

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Bayside Watch Tool
Elgin National Watch
Gallien, R. P.
Koehler Inst. Co.
Levin & Son, Louis
Marshall Co.
Pratt & Whitney
South Bend Lathe

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Chicago Dial Ind. Co.
Federal Products Corp.
Instrument Dev. Labs.

LENSES, Astronomical
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Bausch & Lomb
Binswanger & Co.
Bray Optical Co.
Buchele, W.
Clark & Sons
Dome Precision
E & S Optical
Farrand Optical
Fecker Inc.
Fish-Schurman Corp.
General Scientific
Geophysical Inst. Co.
Glendale Optical
Henson Co., Fred C.
Herron Optical Co.
Howland Optical Co.
Kollmorgen Optical
Palos Optical Co.
Perkin-Elmer Corp.
Phoenix Precision Inst.
Plummer & Kershaw
Simpson Optical
Tinsley Laboratories
Unertl Optical Co.
Univis Lens Co.

LENSES, Burette
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Elgin National Watch
Fish-Schurman Co.
Fisher Scientific Co.
Gaertner Scientific
Glendale Optical
G. M. Mfg. Co.
Microchemical Service
Palos Optical Co.
Parr Instrument Co.
Phoenix Precision Inst.
Precision Scientific Co.
Precision Therm.
Rieker Inst. Co.
Simpson Optical
Swain Nelson Co.
Unertl Optical Co.

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Bausch & Lomb
Binswanger & Co.
Crystal Research Labs.
Distillation Products
Dome Precision
E & S Optical
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Ferner Co.
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Gaertner Scientific
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National Research Corp.
Palos Optical Co.
Phoenix Precision Inst.
Plummer & Kershaw
Simpson Optical
Tinsley Laboratories
Unertl Optical Co.
Univis Lens Co.
Zenith Optical

LENSES, Microscope, etc.
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American Lens Co.
American Optical
Bausch & Lomb Optical
Binswanger & Co.
Boehmke Optical Co.
Bray Optical Co.
Burke & James
Dome Precision
Fecker, Inc.
Ferner Co.
Fish-Schurman Corp.
Gaertner Scientific Corp.
General Scientific
Geophysical Inst. Co.
Glendale Optical
Henson Co., Fred C.
Leitz, Inc.
Palos Optical Co.
Penn Optical & Inst.
Phoenix Precision Inst.
Plummer & Kershaw
Schneider-Cogswell
Simpson Optical
Unertl Optical Co.
Univis Lens Co.
Zeiss, Inc., Carl
Zenith Optical Co.

LENSES, Polarized
Bausch & Lomb
Dome Precision
General Scientific
Henson Co., Fred C.
Palos Optical Co.
Pfaltz & Bauer, Inc.
Phoenix Precision Inst.
Polarizing Inst. Co.
Unertl Optical Co.
Valpey Crystals
Zenith Optical Co.

LENSES, Thermometer (See Lenses, Burette)

LEVELS, Dumpy (See Surveying Instruments)

LEVELS, Engineer's (See Surveying Instruments)

LEVELS, Hand
Alpha Instrument Co.
Bostrom-Brady
Brunning Co., Inc.
Dietzen Co.
Ferner Co.
Gurley, W. & L. E.
Keuffel & Esser Co.
Leupold & Stevens
Millers Falls
Pittsburgh Inst. & Mach.
Pratt & Whitney
Standard Thermometer
Starrett Co.
Suverkop Instruments
United States Blue Print
Warren-Knight Co.
Weber Co., F.
White Co. Inc., David

LEVELS, Precision
Alpha Instrument Co.
Berger & Sons
Ferner Co.
Fish-Schurman Co.
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Gray Instrument
Gurley, W. & L. E.
Heiland Research
Keuffel & Esser Co.
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Rieker Instrument Co.
Scherr Co., Inc.
Starrett Co.
Warren-Knight Co.
Weber Co., F.
White Co., Inc., David
Zeiss, Inc., Carl

LEVELS, Prism
Berger & Sons
Fecker, J. W.
Keuffel & Esser Co.
Taylor Inst. Cos.
White Co. Inc., David

LEVELS, Spirit
Boeckler Instrument
Dietzen Co.
Electronic Products
Ferner Co.
Geir & Bluhm, Inc.
Glogau & Co.
Gray Instrument
Gurley, W. & L. E.
Keuffel & Esser Co.
Ruehfel Co.
Warren-Knight Co.
White Co. Inc., David

LEVELS, Surveying (See Surveying Instruments)

LEVELS, (Wye (See Surveying Instruments)

LIGHT METERS (See Photometers, Illumination)

LIGHT SOURCES see also Gas & Vapor Discharge Tubes

LIGHT SOURCES, "Daylight"
American Optical Co.
Atlas Electric Co.
Burton Manufacturing
Continental Electric
Electronic Products
E & S Optical
Gates & Co.
General Elec. Co.
Larremore Sales Co.
Macbeth Corp.
Stocker & Yale
Sylvania Elec. Prod.

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Bausch & Lomb Optical
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Eby, Inc.
Fisher-Pierce Co.
Fredericks, George
Gaertner Scientific Co.
Gates & Co.
General Elec. Co.
G-M Labs.
Larrimore Sales Co.
Leitz, Inc., E.
Macbeth Corp.
Stocker & Yale
Sylvania Elec. Prod.

LIGHT SOURCES, Monochromatic
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American Inst. Co.
Baird Associates
Bausch & Lomb Optical
Central Scientific Co.
Dearborn Scientific
DoAll Co.
Ferner Co.
Fish-Schurman Co.
Fuess, Inc.
Gaertner Scientific Corp.
Gates & Co.
General Elec. Co.
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Optron Laboratory
Pfatz & Bauer, Inc.
Phoenix Prec. Inst.
Polarizing Instrument
Rudolph & Sons
Scherr Co., Inc.
Van Keuren Co.

LIGHT SOURCES, Ultra-Violet
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Baird Associates
Burton Mfg. Co.
Central Scientific Co.
Continental Electric
Dietert Co.
Electronic Products
E & S Optical
Ferner Co.
Fredericks, George
Gaertner Scientific Corp.
Gates & Co.
General Elec. Co.
Hanovia Chem. & Mfg.
Jarrell-Ash Co.
Laboratory Specialties
Leitz Inc.
Magnaflux Corp.
Mico Instrument Co.
Pfaltz & Bauer, Inc.
Phoenix Precision Inst.
Photovolt Corp.
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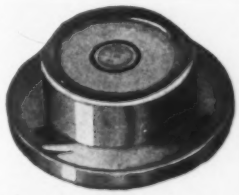

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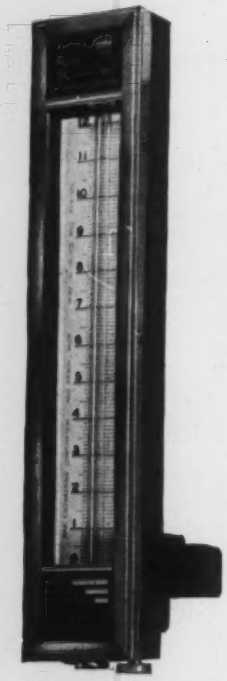

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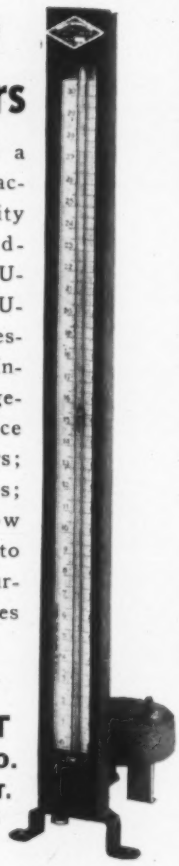

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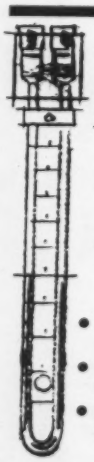

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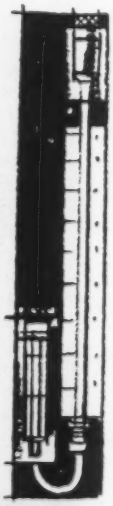

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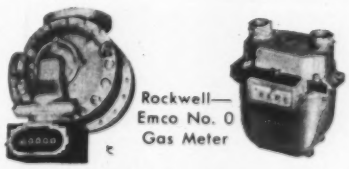
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METERS, Proportional
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METERS, Reactive Component
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Westinghouse Elec.
Weston Electrical Inst.

METERS, Rotary Displacement
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Bailey Meter Co.
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Hagan Corp.
Hays Corp.
Leupold & Stevens
Mason-Neilan Regulator
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METERS, Shunt
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Instrument Resistors
Radio City Products
Rawson Electrical Inst.
Reiner Electrontes
Sangamo Electric
Shalleross Mfg.
Wheelco Inst. Co.
Westinghouse Elec.

METERS, Sight Flow
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Brooks Rotameter Co.
Commercial Research
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Henszey Co.
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METERS, Station
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METERS, Steam (See Flowmeters, Steam)

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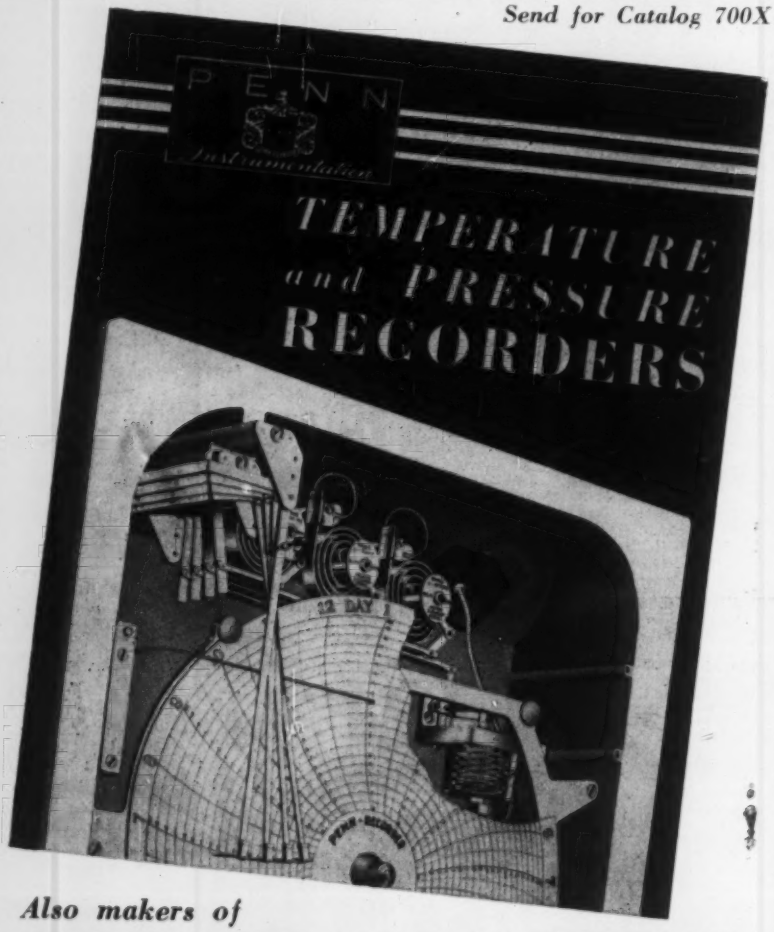

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Precision Scientific
Stocker & Yale
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Ferner Co.
Jarrell-Ash Co.
Leitz, Inc.
Zeiss, Inc.

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Bausch & Lomb Optical
Boehmke Optical Co.
Federal Mfg. & Eng.
Ferner Co.
Jarrell-Ash Co.
Leitz, Inc.
Polarizing Instrument
Scherr Co., Inc.
Zeiss, Inc., Carl

MICROSCOPES, Biological (See Microscopes, Binocular)

MICROSCOPES, Brinell
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Boeckeler Instrument
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Polarizing Instrument

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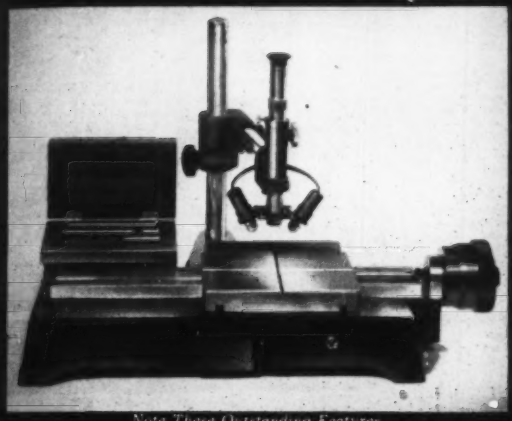

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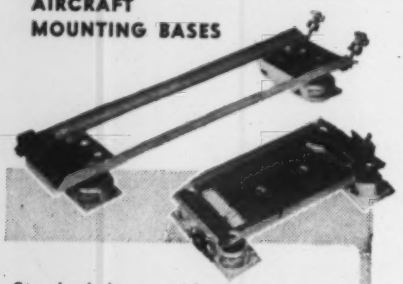

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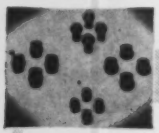

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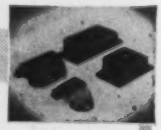

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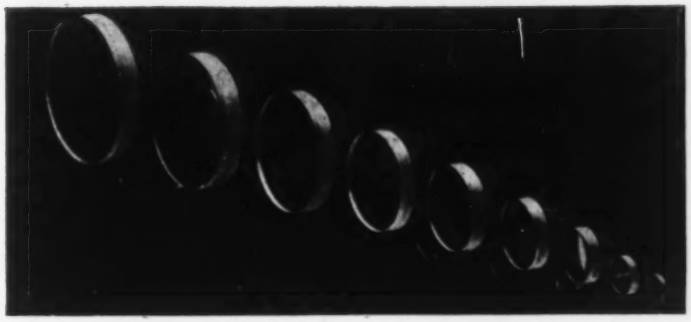

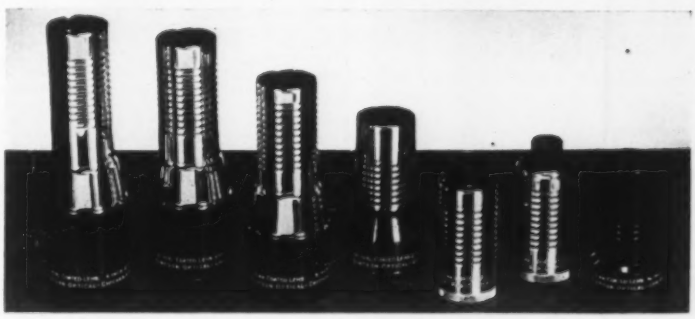

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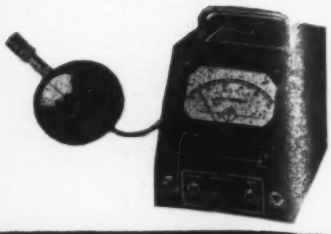

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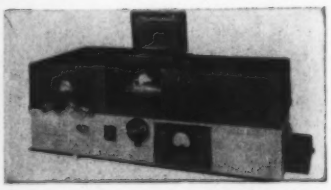

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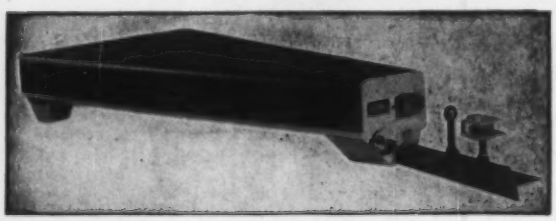

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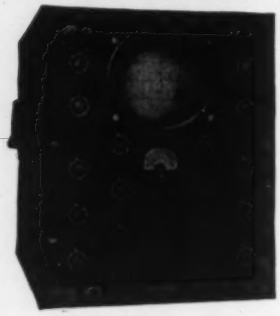

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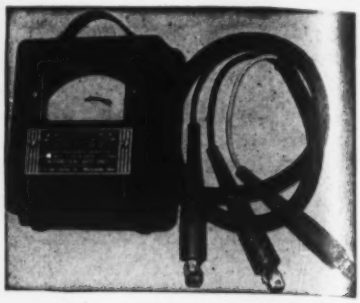

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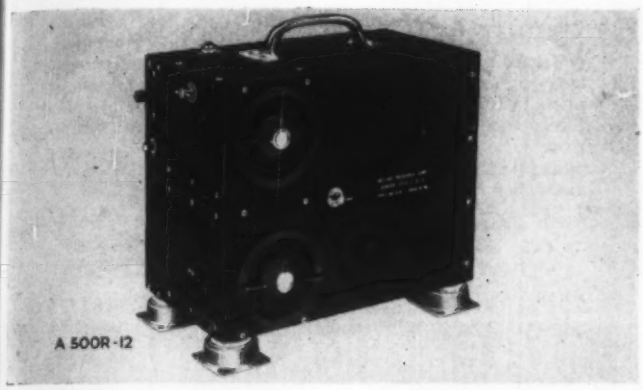

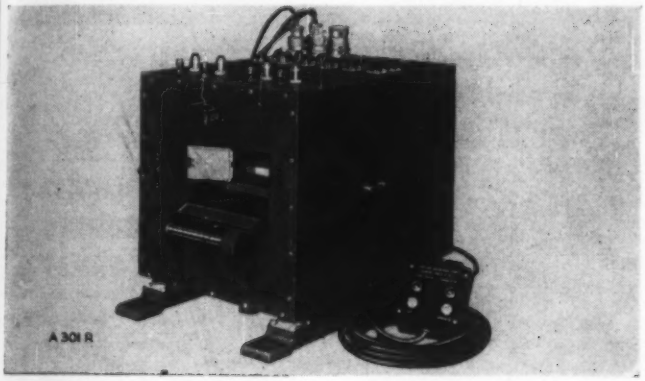

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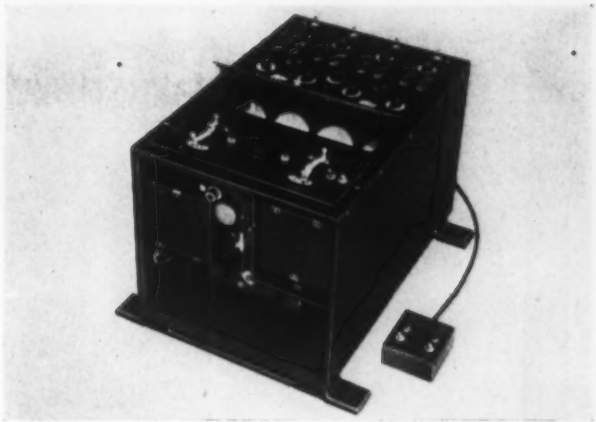

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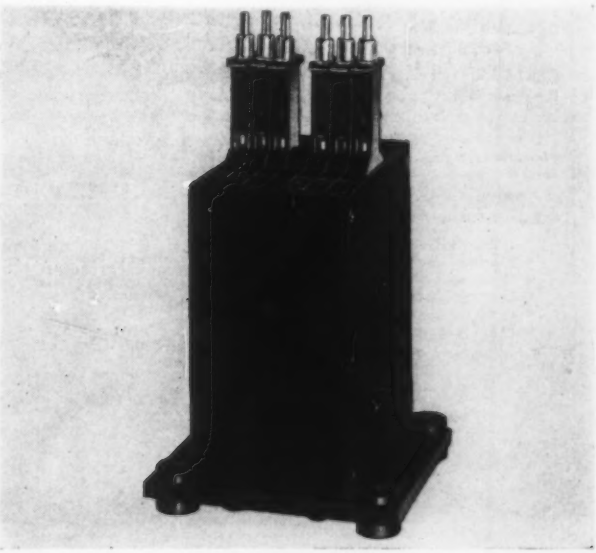

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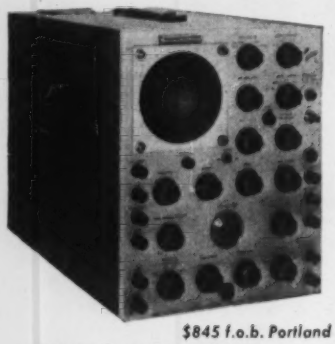

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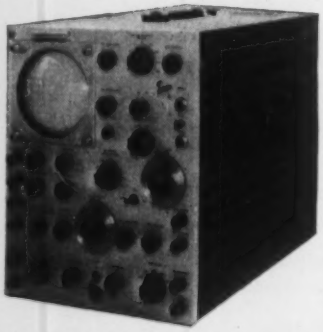

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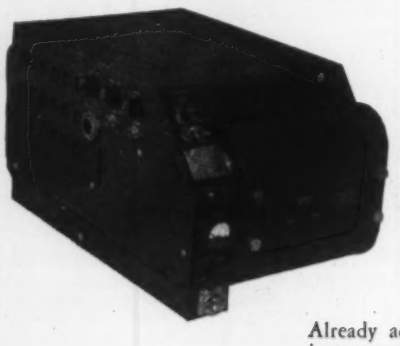

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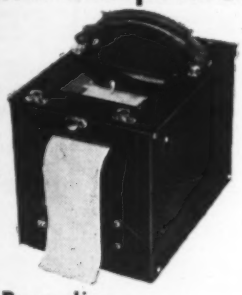

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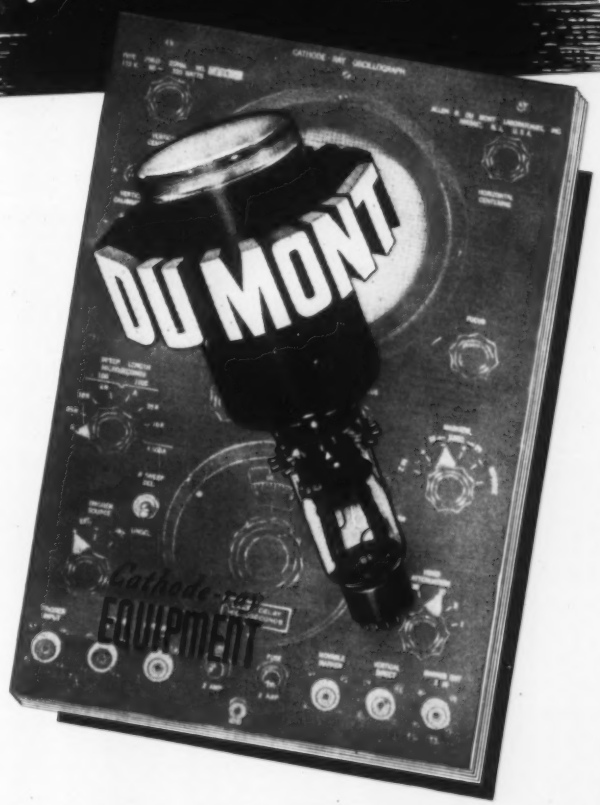

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Bristol Co.
Brown Inst. Div.
Electronic Prod. Co.
Foxboro Co.
General Elec. Co.

(Continued)

Gordon Co., Claud S.
Lear, Inc.
Leeds & Northrup Co.
Lewis Engg. Co.
Sound Appartus
Summers Gyroscope
Tagliabue Corp., C. J.
Weston Elec. Inst. Corp.
Wheelco Inst. Co.
Yardeny Eng.

POTENTIOMETERS., Indicating
Bailey Meter Co.
Bristol Co.
Brown Inst. Div.
Cambridge Inst. Co.
Centraub Div.
Dickson Co.
Distillation Products
Electronic Dev. Lab.
Foxboro Co.
General Elec. Co.
Geophysical Inst. Co.
Giannini & Co.
Gordon Co., Claud S.
Gray Instruments
Hellige, Inc.
J-B-T Instrs., Inc.
Leeds & Northrup Co.
Lewis Engg. Co.
Miller, M. C.
Remier Co., Ltd.
Rowe Engineering
Rubicon Co.
Schwien Eng. Co.
Summers Gyroscope
Tagliabue Corp., C. J.
Thwing-Albert Instrument
Wheelco Inst. Co.
Weston Elec. Inst. Co.

POTENTIOMETERS, Recording
American Inst. Co.
Bailey Meter Co.
Bristol Co.
Brown Inst. Div.
Clarostat Mfg. Co.
Distillation Products
Edin Electronics
Foxboro Co.
Giannini & Co.
Gordon Co., Claud S.
Leeds & Northrup Co.
Lewis Engg. Co.
Mason Neilan Regulator
Sound Apparatus
Summers Gyroscope
Tagliabue Corp., C. J.
Thwing-Albert Instrument

POTENTIOMETERS (Voltage dividers)
Carter Parts Div.
Centralab Div.
Clarostat Mfg. Co.
Daven Co.
De Jur-Amsco Corp.
Electronic Associates
Foxboro Co.
Fairchild Camera
Ford Engineering
General Radio Co.
Giannini & Co.
Heilpot Corp.
Leeds & Northrup
Ohmite Mfg.
International Resistance
Natl. Elec. Controller
Rubicon Co.
Shallcross Mfg. Co.
Summers Gyroscope
Technology Inst. Corp.
Thwing-Albert Inst.
Van Dyke Instruments
Ward Leonard Elec. Co.

POWDERED MATERIALS MEASUREMENTS (See Granular Materials)

POWER FACTOR INDICATORS
Clough-Brengle Co.
Cole Instrument
Elec. Facilities, Inc.
General Elec. Co.
Hickok Elec. Inst. Co.
Leeds & Northrup Co.
Roller-Smith Co.
Sensitive Research Inst.
Triplett Elec. Inst.
Westinghouse Elec.
Weston Electric Inst.

POWER FACTOR RECORDERS
Cole Instrument
Elec. Facilities Inc.
Esterline-Angus Co.
General Elec. Co.
Leeds & Northrup Co.
Roller-Smith Co.
Sorenson & Co.
Westinghouse Elec.

POWER FACTOR REGULATORS
General Electric Co.
Leeds & Northrup Co.
Modern Controls
Shallcross Controls
Vaughn-G. E. Witt Co.
Westinghouse Elec.

POWER-LEVEL INDICATORS
Amplifier Co.
Audio Instrument
Clough-Brengle Co.
Cole Instrument
Daven Co.
De Jur-Amsco
Electronic Dev. Lab.
General Elec. Co.
General Radio Co.
Hickok Elec. Inst. Co.
Leeds & Northrup
Marion Electrical Inst.
RCA Manufacturing
Sensitive Research Inst.
Shallcross Mfg. Co.
Sound Apparatus Co.
Westinghouse Elec.
Weston Elec. Inst.

PRECISION-BORE GLASS TUBING
Ace Glass Inc.
Brooks-Rotameter
Corning Glass Works
Fischer & Porter
Fich-Schurman Co.
Fredericks Co., Geo.
Kontes Glass Co.
Mercury Glass Co.
Phoenix Prec. Inst.
Porter, George K.
Scientific Glass App.

PRECISION-BORE METAL TUBING
Precision Tube Co.

PRESSES, Laboratory
American Inst. Co.
Anderson Bros. Mfg. Co.
Baldwin Locomotive
Carver, Fred S.
Central Scientific Co.
Denison Engineering
Emmett Machine
Laboratory Specialties
Microchemical Service
Williams Apparatus

PRESSES PELLET
Black & Webster
Central Scientific Co.
Denison Engineering
Dietert Co.
Elmer & Amend
Hannifin Mfg. Co.
Microchemical Service
Parr Instrument Co.
Precision Scientific
Stokes Machine Co.

PRESSURE CONTROLLERS, AUTOMATIC (See Controllers, Automatic, Pressure)

PRESSURE, High (Above 1000 lbs.) Indicators
Aeroquip Corp.
American Mach. & Metal
Acra Regulator, Inc.
Ashton Valve Co.
Atlas Valve Co.
Automatic Temp. Control
Bailey Meter Co.
Baldwin Locomotive
Bristol Co.
Brooke Eng. Co.
Brown Inst. Div.
Clark Cooper Co.
Clapp Instrument Co.
Cook Electric
Crosby Steam Gage
Electro Prod. Lab
Electronics Products Co.
Elematic Equip. Corp.
Emery Co., A. H.
Fisher Governor Co.
Flader, Inc., Frederic
Foxboro Co.
Gothman Inst. Co.
Hays Corp.
Heise Bourdon Tube Co.
Kollsman Inst. Co.
Leeds & Northrup
Linde Air Products Co.
Manning, Maxwell & Moore
Mansfield & Green
Marsh Corp.
Marshalltown Mfg.
Mason Neilan Regulator
McAlear Mfg. Co.
Parks Co., Harry S.
RCA Manufacturing Co.
Republic Flow Meters
Ruska Inst. Corp.
Sheffield Corp.
Star Brass Mfg. Co.
Statham Labs
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Thrush & Co., H. A.
Trerice Co
U. S. Guage
Weksler Thermometer
Wheelco Instruments

PRESSURE, HIGH (Above 1000 lbs.) Recorders
Aeroquip Corp.
American Inst. Co.
Annis Co.
Automatic Temp. Control
Bailey Meter Co.
Baldwin Locomotive
Bristol Co.
Brown Inst. Div.
Builders-Providence
Cambridge Inst. Co.
Cash Co.
Clark Cooper Co.
Commercial Research
Cook Electric
Crosby Steam Gage Co.
Dickson Co.
Emery Co., A. H.
Esterline-Angus Co.
Flader, Inc., Fredric
Foxboro Co.
Gotham Inst. Co.
Hathaway Inst. Co.
Hays Corp.
Leeds & Northrup
Linde Air Products Co.
Manning, Maxwell & Moore
Mason-Neilan Regulator
Parks Co., Harry S.
Penn Ind. Instrument
Republic Flow Meters Co.
Sheffield Corp.
Statham Labs.
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Trerice Co.
U. S. Gage Co.
Weksler Themometer
Wheelco Instruments

PRESSURE, HIGH (Above 1000 lbs.) Testing Devices
American Inst. Co.
Ashton Valve Co.
Bailey Meter Co.

(Continued)

Baldwin Locomotive
Builders-Providence
Carver, Fred S.
Cook Electric
Crosby Steam Gage Co.
Dillon & Co.
Electro Products Labs
Flader, Inc., Frederic
Foxboro Co.
Hathaway Inst.
Hawk Tool & Eq.
Manning, Maxwell & Moore
Marsh Corp.
Martin-Hubbard Corp.
Nason Co.
Parks Co., Harry S.
Parr Instrument Co.
Penn Ind. Instrument
Pioneer Instrument
RCA Manufacturing Co.
Refinery Supply Co.
Sheffield Corp.
Trerice Co.

PRESSURE INDICATORS, Bellows
Autocall Co.
Automatic Temp. Control
Bailey Meter Co.
Barton Inst. Co.
Bridgeport Thermostat
Bristol Co.
Brown Inst. Div.
Clapp Instrument Co.
Cook Electric Co.
Crosby Steam Gage Co.
Defender Inst. & Reg.
Dickson Co.
Emery Co., A. H.
Foxboro Corp.
Giannini & Co.
Gotham Inst. Co.
Hays Corp.
Manning, Maxwell & Moore
Marshalltown Mfg.
Mason-Neilan Regulator
Panellit, Inc.
Perfex Corp.
Precision Therm.
Republic Flow Meters
Shallcross Controls
Summers Gyroscope
Tagliabue Corp., C. J.
Taylor Inst. Cos
Trerice Co.
U. S. Gage
Wallace & Tiernan
Weksler Thermometer

PRESSURE INDICATORS, Bourdon-tube see Gages, Bourdon

PRESSURE INDICATORS, Diaphrams, etc.
Automatic Temp. Control
Bailey Meter Co.
Brown Inst. Div.
Clapp Instrument
Cook Electric
Dickson Co.
Eclipse-Pioneer Div.
Electro Products Labs
Emery Co., A. H.
Engineering Res. & Dev.
Foxboro Co.
Gotham Inst. Co.
Hays Corp.
Kollsman Inst. Div.
Manning, Maxwell & Moore
Marsh Corp., Jas. P.
Marshalltown Mfg.
Mason-Neilan Regulator
Moore Products
Perfex Corp.
Photocon Research
Powers Regulator Co.
Republic Flow Meters
Rochester Mfg. Co.
Ruska Inst. Corp.
Shallcross Controls
Sheffield Corp.
Summers Gyroscope
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Trerice Co.
Trimount Inst. Co.
U. S. Gage
Viking Instruments

PRESSURE INDICATORS, Electrical resistance
Aeroquip Corp.
Baldwin Locomotive
Cole Instrument
Cook Electric
Electro Products Lab
Engineering Res. & Dev.
Flader, Inc., Fredric
Foxboro Co.
General Elec. Co.
Hathaway Instrument
Rowe Engineering
Rubicon Co.
Shallcross Controls
Sheffield Corp.
Skaneateles Mfg. Co.
Statham Labs.
Trimount Inst. Co.
U. S. Gauge Co.

PRESSURE INDICATORS, Inverted-bell
Automatic Temp. Control
Barharach Indus. Inst.
Bailey Meter Co.
Bristol Co.
Brown Inst. Div.
Defender Inst. & Reg.
Dickson Co.
Foxboro Co.
Hays Corp.
Magnetrol Inc.
Mason-Neilan Regulator
Republic Flow Meters
Shallcross Controls
Taylor Inst. Cos.
Uehling Inst. Co.

PRESSURE INDICATORS, Membrane
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Perfex Corp.
Taylor Instrument Cos.

CAMBRIDGE SURFACE PYROMETERS *Roll . . Needle . . Mold*

The routine use of Cambridge Surface Pyrometers takes the guesswork out of surface temperature determination in the plants and laboratories of many industries. The CAMBRIDGE is accurate, dependable, rugged, quick-acting and easy to use.

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Brush Development Co.
Commercial Research
Crystal Research Labs.
Matrin-Hubbard Corp.
Massa Labs.
RCA Manufacturing

PRESSURE INDICATORS, Piston, Weight-loaded
American Inst. Co.
Bailey Meter Co.
Coleman Inst. & Mfg.
Hagan Corp.
Mansfield & Green
Republic Flow Meters
Ruska & Co.

PRESSURE INDICATORS, Single-tube, liquid column
Bacharach Indus. Inst.
Dwyer Mfg. Co.
Electronic Products Co.
Gas App. Specialties
Ideal Lab. Tool
Manning, Maxwell & Moore
Meriam Instrument
Parks Co., Harry S.
Precision Therm.
Uehling Instrument Co.

PRESSURE INDICATORS, Spring-loaded piston
Bacharach Indus. Inst.
Commercial Research
Mansfield & Green

PRESSURE INDICATORS, U-tube
American Meter Co.
Amthor Test. Mach.
(Continued)

Automatic Temp. Control
Bacharach Indus. Inst.
Bailey Meter Co.
Connelly Iron Sponge
Defender Inst. & Reg.
Dwyer Mfg. Co.
Electronics Products Co.
Friez Instrument Div.
Gas App. Specialties
Gotham Inst. Co.
Hays Corp.
Ideal Lab. Tool
Manning, Maxwell & Moore
Mason-Neilan Regulator
Meriam Instrument
Moeller Instrument Co.
Parks Co., Harry S.
Precision Therm.
Refinery Supply Co.
Ruska Inst. Corp.
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Trerice Co.
Trimount Inst. Co.
Uehling Instrument Co.
Vapor Recovery System

PRESSURE RECORDERS, Bellows
Automatic Temp. Control
American Meter Co.
Bailey Meter Co.
Bridgeport Thermostat
Bristol Co.
Brown Inst. Div.
Cook Electric
Crosby Steam Guage
Defender Inst. & Reg.
Dickson Co.
Esterline-Angus Co.
(Continued)

Flader Inc., Fredric
Foxboro Co.
Gorrell & Gorrell
Gotham Inst. Co.
Hays Corp.
Manning, Maxwell & Moore
Mason-Neilan Regulator
Penn Ind. Inst. Corp.
Republic Flow Meters
Summers Gyroscope
Tagliabue Corp., C. J.
Taller & Cooper
Taylor Inst. Cos.
Weksler Thermometer

PRESSURE RECORDERS, Bourdon tube
Automatic Temp. Control
American Meter Co.
Bailey Meter Co.
Baldwin Locomotive
Bristol Co.
Brown Inst. Div.
Builders-Providence
Crosby Steam Guage
Defender Inst. & Reg.
Dickson Co.
Electro Products Lab.
Esterline-Angus Co.
Foxboro Co.
Giannini & Co.
Gordon Co., Claud S.
Gotham Inst. Co.
Hays Corp.
Improved Guage Mfg. Co.
Kenyon Instrument Co.
Leeds & Northrup Co.
Manning, Maxwell & Moore
Marsh Corp., Jas. P.
Mason-Neilan Regulator
Moeller Inst. Co.
Penn Ind. Inst. Corp.
Republic Flow Meters
Summers Gyroscope
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Thrush & Co., H. A.
Trerice Co.
U. S. Guage
Weksler Thermometer

PRESSURE RECORDERS, Capsular spring
Automatic Temp. Control
Cook Electric
Manning, Maxwell & Moore
Penn Ind. Inst. Co.
Republic Flow Meters
Tagliabue Corp., C. J.

PRESSURE RECORDERS, Diaphram
Automatic Temp. Control
Bailey Motor Co.
Bristol Co.
Brown Inst. Div.
Cook Electric
Defender Inst. & Reg.
Dickson Co.
Electro Products Labs.
Engineering Res. & Dev.
Foxboro Co.
Giannini & Co.
Gotham Inst. Co.
Hays Corp.
Manning, Maxwell & Moore
Marsh Corp., Jas. P.
Mason-Neilan Regulator
Penn Ind. Inst. Corp.
Republic Flow Meters
Sanborn Co.
Sheffield Corp.
Tagliabue Corp., C. J.
Taylor Inst. Co.
Wheelco Instruments

PRESSURE RECORDERS, Electrical-resistance
Aeroquip Corp.
Baldwin Locomotive
Cole Instrument
Engineering Res. & Dev.
Flader Inc., Fredric
Giannini & Co.
Hathaway Instrument
Republic Flow Meters
Sheffield Corp.
Statham Labs.
Summers Gyroscope
Trimount Inst. Co.
Yellow Springs Inst. Co.

PRESSURE RECORDERS, Inverted-bell
American Meter Co.
Automatic Temp. Control
Bacharach Indus. Inst.
Bailey Meter Co.
Bristol Co.
Brown Inst. Div.
Dickson Co.
Foxboro Co.
Hays Corp.
Leeds & Northrup Co.
Mason-Neilan Regulator
Penn Ind. Inst. Corp.
Republic Flow Meters
Taylor Inst. Cos.
Uehling Instrument Co.

PRESSURE RECORDERS, Membrane
Bailey Meter Co.
Defender Inst. & Reg.
Hays Corp.
Mason-Neilan Regulator
Republic Flow Meters
Taylor Inst. Cos.

PRESSURE RECORDERS, Piezoelectric
Brush Development Co.
Massa Labs.
RCA Manufacturing Co.

PRESSURE RECORDERS, Piston, weight-loaded
Bailey Meter Co.

PRESSURE RECORDERS, Single-tube liquid column
Trerice Co.
Uehling Instrument Co.

PRESSURE RECORDERS, Spring-loaded piston
Bacharach Indus. Inst.
Baldin Locomotive
Commercial Research
Esterline-Angus Co.
Hays Corp.

PRESSURE RECORDERS, U-tube
Automatic Temp. Control
Bailey Meter Co.
Brown Inst. Div.
Foxboro Co.
Gorrell & Gorrell
Hays Corp.
Manning, Maxwell & Moore
Mason-Neilan Regulator
Penn Ind. Inst. Co.
Republic Flow Meters
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Trerice Co.
Uehling Instrument Co.

PRESSURE SNUBBERS
American Meter Co.
Ashton Valve Co.
Brown Inst. Div.
Campell Co., J. A.
Fischer & Porter
Manning, Maxwell & Moore
Mansfield & Green
Marsh Corp.
Martin Decker Corp.
McAlear Mfg. Co.
Meriam Instrument
Micro Metallic Corp.
National Engg. Products
Parker Appliance
Wilkus Mfg. Co.

PRISMS
Alpha Instrument Co.
American Optical
Bausch & Lomb Opt.
Binswanger & Co.
Boehmke Optical Co.
Buchele Optical Co.
Cadillac Glass Co.
Clark & Sons
Dearborn Scientific
Eclipse-Pioneer Div.
Fish-Schurman Co.
Fecker, J. W.
Gaertner Scientific Corp.
Geophysical Inst. Co.
Glendale Optical
Goerz Amer. Optical Co.
Hayward Optical Glass
Henson Co., Fred C.
Jarrell-Ash Co.
Keuffel & Esser Co.
Kollmorgen Optical Co.
Machlett & Son
Optron Laboratory
Palos Optical Co.
Perkin-Elmer Corp.
Plummer & Kershaw
Robinson Optical
Schneider-Cogwell
Simpson Optical
Univis Lens Co.
Valpey Crystals

PROCESS TIMING INSTRUMENTS (See Timers, Automatic Process)

PROGRAM CLOCKS (See Timers, Automatic Process)

PROJECTORS, Color Film
American Optical
Bausch & Lomb Optical
Bell & Howell Co.
Bolsey Corp.
Bray Optical Co.
De Vry Corp.
Dome Precision
Eastman Kodak Co.
G-M Laboratories
Leitz, Inc.
RCA Manufacturing

PROJECTORS, Film Slides, Lantern Slide & Opaque Object
Aloe Co., A. S.
American Meas. Insts.
American Optical
Bausch & Lomb Optical
Bell & Howell Co.
Bolsey Corp.
Ruston Mfg. Co.
DeVry Corp.
Dome Precision
Eastman Kodak Co.
Fish-Schurman Corp.
G-M Laboratories
Leitz, Inc.
Pflatz & Bauer
Zeiss, Inc.

PROJECTORS, Rectifying
Abrams Instrument

PRONY BRAKES, Hydraulic
Taylor Dynamometer

PROTRATORS, Bevel (See Drawing Instruments)

PROTRACTORS, Course
Alpha Instrument Co.
Bliss & Co.
Instrumaster Industries
Kenyon Instrument Co.
Keuffel & Esser Co.
Marine Compass Co.
Negus, T. S. & J. D.
Warren-Knight Co.

PROTRACTORS, Navigator's (See Protractors, Course)

PROTRACTORS, Transparent (See Drawing Instruments)

PROVERS, Gas Meter
American Meter Co.
Precision Scientific
Superior Meter Co.

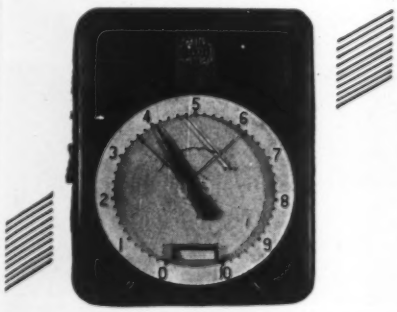
PROVING RINGS
Baldwin Locomotive
Morehouse Machine Co.
Olsen Testing Machine
Pittsburgh Inst. & Mech.
Steel City Test. Mach.

PSYCHOLOGY LABORATORY APPARATUS
Brush Development Co.
Electro-Medical Lab.
General Radio Co.
Gorrell & Gorrell
Martin-Hubbard Corp.
Phipps & Bird, Inc.
Stoelting Co., C. H.

PSYCHROMETERS, Aspiration
Brown Inst. Div.
Friez Instrument Div.
G. M. Mfg. Co., Inc.
Gotham Instrument
Green, Henry J.
H-B Inst. Co.
Instruments Corp.
Johnson Service Co.
Kahl Sci. Inst. Co.
Mason-Neilan Regulator
Moeller Instrument Co.
Palmer Co.

PSYCHROMETERS, Electric (See Psychrometers, Aspiration)

PSYCHROMETERS, Recording (See Hygrometers, Recording)



BAILEY
Electronic Pyrometer

● This indicating, recording, and controlling BAILEY PYROTRON is a self balancing potentiometer which records one or two temperatures continuously on a 12-inch diameter chart and indicates on a 29-inch bold scale. It may be furnished with air-operated, electric, or electronic control.

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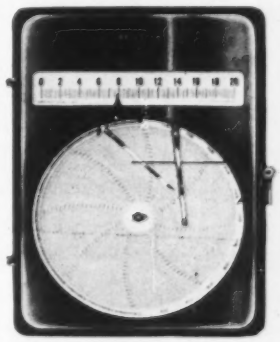
Bailey Meter Company Ltd., Montreal, Canada

PYROMETERS



Bristol's line of pyrometers includes potentiometer, millivoltmeter, thermocouple and radiation types for temperatures up to 3600° F; automatic controllers, recorders and indicators; electronic pyrometer controllers.

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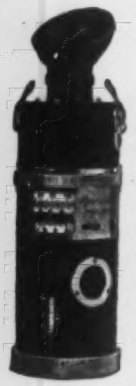
PYRO

The Accurate Way to Measure Temperatures

. . . at a glance . . .



The simplified PYRO Optical Pyrometer

SELF-CONTAINED. No accessories, no upkeep. Direct reading.

ACCURATE. Permits close and rapid temp. determination — even on minute spots, fast-moving objects, smallest streams. ("Special Foundry Type" and "Triple Range" also have RED Correction Scale for determining true spout and pouring temps. of molten iron, steel in the open.)

LIGHT IN WEIGHT-Only 3 lbs. complete. Handy.

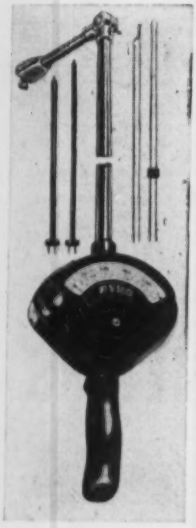
Stock Ranges 1400° F. to 7500° F.

Write for FREE Catalog No. 80

Just sight it . . . and press the button!

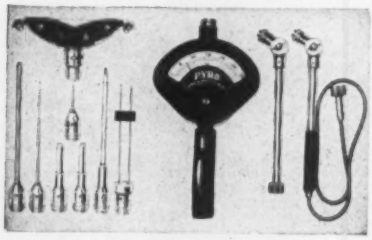
NEW PYRO Radiation Pyrometer

Any operator can determine spot temperatures in kilns, fire boxes, furnaces, ovens, etc., accurately—instantly—with the New PYRO Radiation Pyrometer. No thermocouples, lead wires or other accessories needed—the PYRO is completely self-contained. Just sight it at the object . . . and press the button. Temperature indicated instantly on large direct-reading dial. Two double ranges available 1000/1800 — 1800/2600° and 1400/2400—2400/3600° F. Write for FREE Catalog No. 100.



BETTER TEMPERATURE CONTROL FOR NON-FERROUS FOUNDRIES

The PYRO Immersion Pyrometer is shock, moisture, and dustproof, immune to magnetic influences. Shielded steel housing. Instantly interchangeable bare metal and protected type thermocouples without adjustment or recalibration. Large 4" scale. Equipped with exclusive Lock Swivel. Ranges 0-1500 and 0-2500 F. Get FREE Catalog No. 150.



8 PYRO Instruments, all in one!

The NEW PYRO Surface Pyrometer handles all surface temperature measuring jobs. Has 8 types of thermocouples; all interchangeable in seconds with no recalibration or adjustment. Automatic cold end compensator, shock, moisture, and dustproof. Accurate, big 4¾" indicator. Available in 5 temperature ranges. Get FREE Catalog No. 160.

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American Inst. Co.
American Moistening Co.
Central Scientific Co.
Chicago Apparatus Co.
Ever Ready Thermometer
Foxboro Co.
Friez Instrument Div.
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Green, Henry J.
H-B Inst. Co.
Huddleston, J. S. F.
Instruments Corp.
Johnson Service Co.
Kahl Sci. Inst. Co.
Laboratory Specialties
Mine Safety App. Co.
Moeller Instrument Co.
Palmer Co.
Phila Thermometer Co.
Precision Scientific
Precision Thermometer
Scientific Inst. Co.
Taylor Inst. Cos.
Trerice Co.
Warren-Knight Co.
Weksler Thermometer

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Electric Scientific Co.
Hellige, Inc.
LaMotte Chemical Prod.
Photovolt Corp.
Precision Scientific Co.
Rieker Inst. Co.
Rubicon Co.
Scientific Glass App.
Taylor & Co., W. A.

PULSATION DAMPER
(See Pressure Snubber)

PULVERIZED MATERIALS MEASUREMENTS
(See Granular Materials)

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Chicago Appratus Co.
Dennison Eng. Co.
Distillation Prods., Inc.
Eclipse-Pioneer Div.

(Continued)

Electronic Products
Fredericks Co., Geo.
Kontes Glass Co.
Machlett & Son
National Research Corp.
Nelson Vacuum Pump
Phoenix Prec. Inst.
Precision Scientific
Refinery Supply Co.
Scientific Glass App.
Sterling Eng. Co.
Stoelting Co., C. H.
Stokes Machine Co.
Uehling Inst. Co.
Universal X-Ray Prods.
Welch Scientific

PUMPS, Hydraulic Control
Adel Precision Prods.
Dusenbury Co.
Eastern Industries, Inc.
Eclipse-Pioneer Div.
Hydraulic Equipment
Precision Scientific
Skaneateles Mfg. Co.
Sundstrand Machine Tool

PYCNOMETERS
Coleman Inst. & Mfg.
Elmer & Amend
Fisher Scientific Co.

(Continued)

G. M. Mfg. Co.
Humboldt Mfg. Co.
Leeds & Northrup
Pyrometer Inst. Co.
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Scientific Glass App.
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PYRHELIOMETERS
Cambridge Inst. Co.
Eppley Lab.
G. M. Mfg. Co.
Kahl Sci. Inst. Co.
Leeds & Northrup Co.
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PYROMETER CALIBRATING SETS
Bristol Co.
Brown Inst. Div.
Cambridge Inst. Co.
DeJur-Amsco
Foxboro Co.
Illinois Testing Labs.
Leeds & Northrup Co.
Lewis Engineering
Pyrometer Inst. Co.
Rubicon Co.
Taco West Corp.
Tagliabue Corp., C. J.
Thwing Albert Inst. Co.
Wheelco Inst. Co.
Winslow Co.

PYROMETERS, Electrical Resistance
Assembly Products
Bailey Meter Co.
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Cambridge Inst. Co.
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Electric Hotpack Co.
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J-B-T Inst., Inc.
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Roller-Smith Co.
Rubicon Co.
Taco West Corp.
Tagliabue Corp., C. J.
Thwing-Albert Inst. Co.
Wheelco Inst. Co.
Winslow Co.

PYROMETERS, Expansion
Burling Instrument Co.
Defender Inst. & Reg.
Ferner Co.
Lewis Engineering
Partlow Corp.
Pyrometer Inst. Co.
Tagliabue Corp., C. J.
Thwing Albert Inst. Co.
Wheelco Instss. Co.

PYROMETERS, Indicating
Assembly Products
Bacharach Indus. Inst.
Bailey Meter Co.
Bristol Co.
Brown Inst. Div.
Burling Inst. Co.
Burrell Tech. Supply
Cole Instrument
Defender Inst. & Reg.
DeJur-Amsco
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Electronic Prod. Co.
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Engelhard, Chas.
Foxboro Co.
Gordon Co., Claud S.
Gray Instrument
Ill. Testing Labs.
J-B-T Instruments
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Lewis Engg. Co.
Marshall Co., L. H.
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Roller-Smith Co.
Rubicon Co.
Taco West Corp.
Tagliabue Corp., C. J.
Tamms Silica Co.
Taylor Inst. Cos.
Thwing-Albert Instrument
Wheelco Inst. Co.
Winslow Co.

PYROMETER, Millivoltmetric
Assembly Products
Beede Elec. Inst.
Bristol Co.
Brown Inst. Div.
Burrell Tech. Sup.
Cambridge Inst. Co.
Cole Instrument
De Jur-Amsco Corp.
Elematic Equip Corp
Engelhard, Chas.
Foxboro Co.
General Elec. Co.
Gordon Co., Claud S.
Gray Instrument
Ill. Testing Labs.
J-B-T Instruments
Meters, Inc.
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Richards Co., Arkley S.
Roller-Smith Co.
Rubicon Co.
Sensitive Research Inst
Taco West Corp
Tamms Silica Co.
Taylor Inst. Cos.
Thwing-Albert Instrument
Wheelco Inst. Co.
Winslow Co.

PYROMETERS, Optical
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Brown Inst. Div.
Burrell Technical Supply
Cambridge Inst. Co
Dietert Co
Electro-Tech Equip
Fisher Scientific Co
Gordon Co., Claud S.
Instrument Dev. Labs.
Leeds & Northrup Co.
Lewis Engineering
Pyrometer Inst. Co.

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Bristol Co.
Brown Inst Div.
Burrell Technical Supply
Cambridge Inst. Co.
Cole Instrument
De Jur-Amsco
Electro-Tech Equip.
Elematic Equip. Corp.
Engelhard, Chas.
Ferner Co.
Foxboro Co.
Gordon Co., Claud S.
Gray Instrument
Ill. Testing Labs.
Instrument Lab., Inc.
J-B-T Instruments
Leeds & Northrup Co.
Lewis Engg. Co.
Meters, Inc.

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Thwing-Albert Instrument
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- for Controlled Volume Pumping
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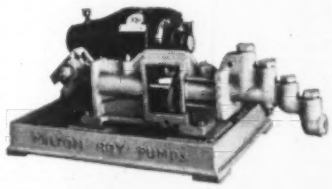
Select Milton Roy Pumps for the above applications . . . pumps that are non-clogging and self-cleaning . . . positive displacement, precise metering units that handle everything from slurries and solids in suspension to the lightest solvents, hot or cold . . . pumps with liquid ends to meet practically every corrosion resistant problem and to pump up to 20 thousand psi for high pressure catalysis and hydrostatic testing.



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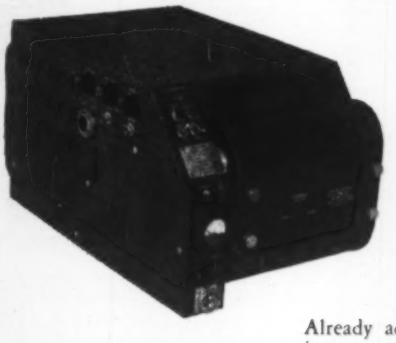

The New

CONSOLIDATED RECORDING OSCILLOGRAPH

18- AND 36-TRACE

Already adopted as the standard instrument by the world's largest users of oscillographs, the new Consolidated Recording Oscillographs are now available commercially.

Featuring continuous records of static or dynamic changes from as many as thirty-six sensing elements at the same time, these new instruments are lighter and more compact than ever, have rapidly attached daylight-loading paper magazines, adjustable paper-speed range from 1/16 to 50 inches per second, and practically automatic, foolproof operation. Full details may be had by requesting Bulletin CEC-1500-X2.

STATIC-DYNAMIC RECORDING SYSTEMS

Three complete systems for measuring and recording, together with associated equipment, are offered by Consolidated Engineering Corporation. These include two amplifying systems for high sensitivity and frequency response in the measurement of stress, strain, vibratory motion, and acceleration, and a direct-recording system employing a strain-gage bridge for measurement of stress, strain, and pressure without use of amplifiers. For additional information send for General Catalog CEC-1300-X3.

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QUARTZ, Fused Quartz Apparatus (see Anparatus, Laboratory, Fused Quartz

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RADIO REMOTE CONTROL SYSTEMS (See Controller Automatic, Radio Remote)

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INKLESS RECTILINEAR Direct Writing RECORDERS

— with extremely high torque movement (200,000 dyne cms), ruggedly built and producing clear, *permanent* records.

Sanborn Direct Writing Recorders offer these advantages, plus performance characteristics (see table below) that make them outstandingly useful in a wide variety of industrial recording applications.

Whenever a phenomenon or action lends itself to transformation to an electrical quantity, and whether the variation is steady or of a pulse type, these Recorders (with associated amplifiers) can be used for immediate, direct, continuous registration.

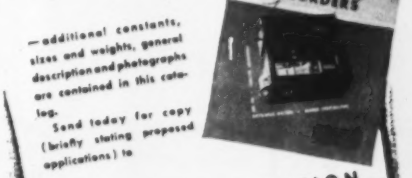
Typical applications, actual and potential, include: temperature changes, automotive noise and vibration, varied output of strain gages and bridges, lightning and earthquake recording, pressure variations, audio frequency response, and many others.

Recording paper (Sanborn Permapaper) is heat sensitive — *eliminating* ink — yet clear and *permanent*. Trace is rectilinear — no curvature, no negative time intervals — yet with totally negligible tangent error.

Sanborn Recorders are available in self-contained, portable recording outfits, complete with cases and controls, or in component form for integration with existing equipment. *Associated amplifiers are also available.*

TABLE OF CONSTANTS

Sensitivity	10 ma/1 cm.
Coil resistance	3,000 ohms, center tapped for push-pull operation.
Critical damping resistance	500 ohms.
Undamped fundamental frequency	45 cycles/sec.
Stylus heater requires from external source	1.25 volts, 3.5 amps, AC or DC.
Maximum undistorted deflection	2.5 cm. each way from center.
Marker requires from external source	1.25 volts, at 1.5 amps, AC or DC.
Paper speed	25 mm/sec.
Chart ruling	1 mm intervals.

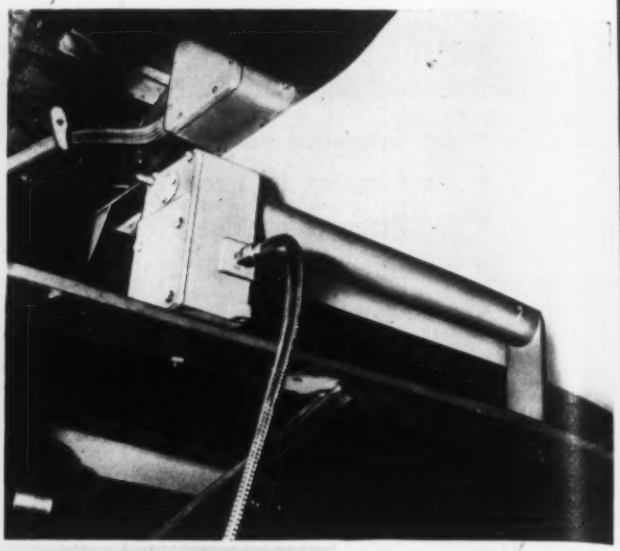


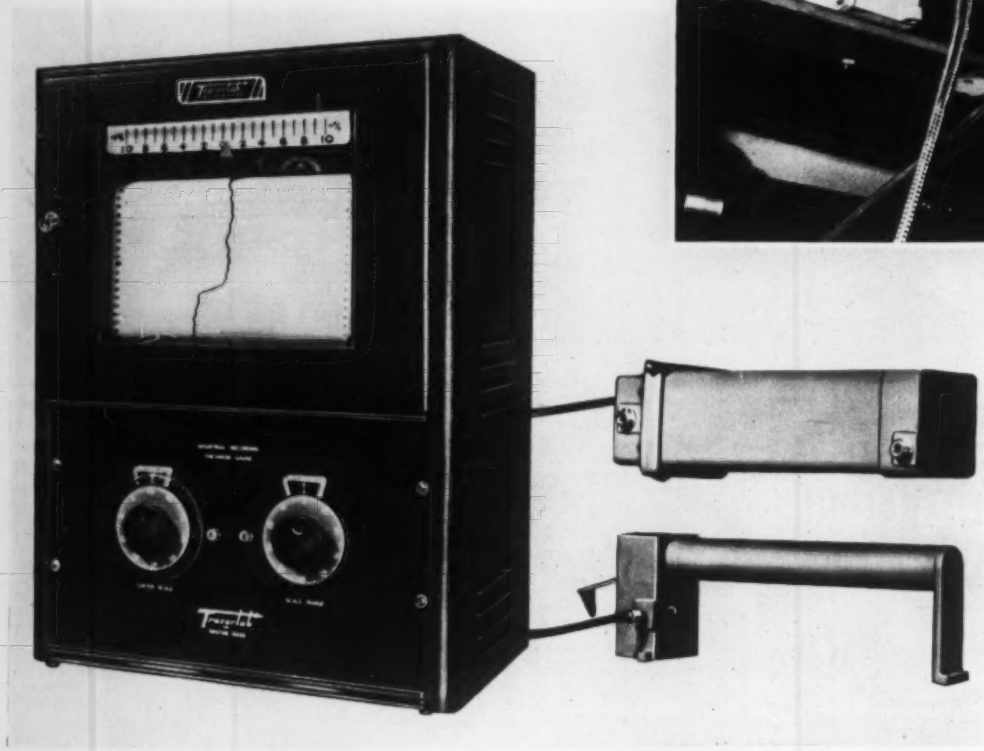
— additional constants, sizes and weights, general description and photographs are contained in this catalog.

Send today for copy (briefly stating proposed applications) to

INDUSTRIAL DIVISION
Sanborn Company
CAMBRIDGE 39, MASSACHUSETTS

The Tracerlab
BETA GAUGE
For PAPER . . . PLASTICS
SHEET METAL . . . TEXTILES





A Tracerlab Beta Gauge installation for measuring paper board at Continental Paper Co., Ridgefield Park, New Jersey.

NON-CONTACTING THICKNESS GAUGE • AUTOMATIC STANDARDIZING FEATURES • EXTREMELY HIGH ACCURACY AND SENSITIVITY • UNAFFECTED BY SHEET COMPOSITION • REGULATED POWER SUPPLY UNNECESSARY • REQUIRES A MINIMUM OF MAINTENANCE

The Tracerlab Beta Gauge is a completely new and unique instrument for measuring and recording weight per unit area or thickness of various materials directly on the production line. It uses beta radiation from Oak Ridge produced radioisotopes to achieve a high degree of accuracy and sensitivity and is unaffected by variations in chemical composition of the material being measured. This is a non-contacting type of gauge designed for the severe operating conditions usually encountered in production operations. In addition to the recording type, a non-recording industrial model and a laboratory model of the Tracerlab Beta Gauge are also available.

Let us know your gauging problems and we will gladly advise you how the Tracerlab Beta Gauge can help you.

Write for Beta Gauge Bulletin 20.

A FEW TYPICAL USES

Measuring weight per unit area or thickness of the following:

VINYL PLASTIC FILM
SHEET RUBBER
CELLOPHANE
PHOTOGRAPHIC FILM BASE
COATED TEXTILES
WAX COATED PAPER
GLASSINE PAPER
CONDENSER PAPER
CARDBOARD
TEXTILE YARN AND ROVING
ALUMINUM FOIL
AUTOMOBILE BODY STEEL
TINPLATE
BRASS SHEET

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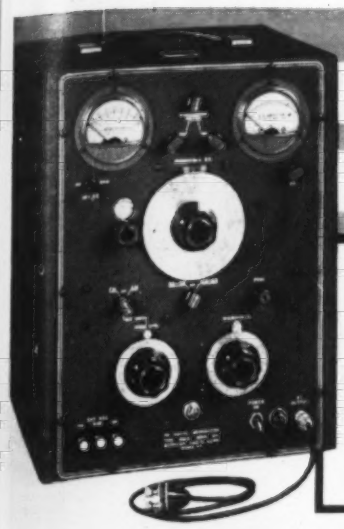
TRACERLAB INC., 130 HIGH STREET, BOSTON 10, MASS.

PRECISION MEASURING INSTRUMENTS FOR THE RADIO AND ELECTRONIC INDUSTRY

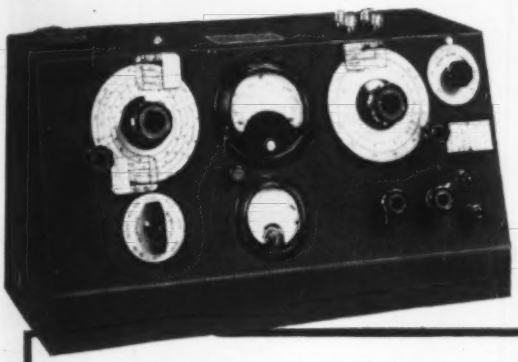


FM SIGNAL GENERATOR *TYPE 202-B*

RF COVERAGE: 54—216 megacycles in two ranges; accuracy ±0.5%.
FM DEVIATION: Three ranges, 0—24 kc., 0—80 kc., 0—240 kc., continuously adjustable.
FM DISTORTION: Less than 2% at 75 kc. deviation.
AMPLITUDE MODULATION: One range, 0—50%; calibrations at 30% and 50% modulation.
INTERNAL MODULATING FREQUENCIES: Eight frequencies from 50 cycles to 15 kc.
RF OUTPUT: 0.1 microvolt to 0.2 volt, continuously adjustable by means of 26.5 ohm piston type attenuator.

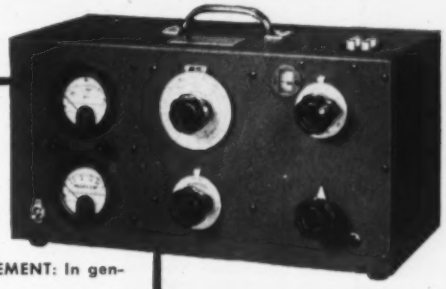
UNIVERTER *TYPE 203-B*

An FM-AM frequency converter accessory with unity gain for use with 202-B FM Signal Generator.
RF RANGE: 0.4 mc. to 25 mc.
RF INCREMENT DIAL: ±250 kc. in 10 kc. increments.
RF OUTPUT: 0.1 microvolt to 0.1 volt, calibrated output (26.5 ohms); 2 volts max. uncalibrated output (approx. 470 ohms).



Q-METER *TYPE 160-A*

FREQUENCY RANGE: 50 kc. to 75 mc. (±1%, 50 kc.—50 mc.; ±3%, 50 mc.—75 mc.). May be extended down to 1 kc. with external accessory oscillator.
RANGE OF Q MEASUREMENTS, COILS: 50—625.
ACCURACY OF Q MEASUREMENT: In general, ±5%.
RANGE OF Q TUNING CAPACITOR: Main Section, 30—450 mmf. (±1% or ±1 mmf., whichever is greater). Vernier Section, plus 3, zero, minus 3 mmf., (±0.1 mmf.).



Q-METER *TYPE 170-A*

FREQUENCY RANGE: 30 mc. to 200 mc. (±1%).
RANGE OF Q MEASUREMENT: 80—1200.
ACCURACY OF Q MEASUREMENT: In general, ±10%.
RANGE OF Q TUNING CAPACITOR: 11—60 mmf. (±1% or ±0.5 mmf., whichever is greater).

QX-CHECKER *TYPE 110-A*

FREQUENCY RANGE: 100 kc. to 25 mc. using accessory plug-in inductors. A calibration sheet is supplied with each inductor, accurate to within ±3%.
RANGE OF COIL CHECKS: Inductors having values between 10 microhenries and 10 millihenries may be checked against a standard to an accuracy of about ±0.2% provided the Q of the inductor is 100 or greater.
CAPACITANCE RANGE: Capacitance values between about 2—1000 mmf. may be checked against standard by direct substitution, with an accuracy of a few tenths of one mmf., provided Q of capacitors is high.

BEAT FREQUENCY GENERATOR *TYPE 140-A*

FREQUENCY RANGE: 20 cycles to 5 megacycles in two ranges; LOW RANGE: 20 to 30,000 cycles. HIGH RANGE: 30 kilocycles to 5 megacycles. Accuracy ±2 cycles up to 100 cycles, ±2% above 100 cycles.
OUTPUT POWER: One watt, available from a variety of output impedances.
ATTENUATOR: 5 steps; X1.0, X0.1, X.01, X.001, X.0001.
DISTORTION: 5% or less.

Write for further information

BOONTON RADIO Corporation
BOONTON·N·J·U·S·A·

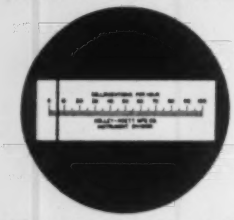
For GREATER ACCURACY ... of Radiation Measurements

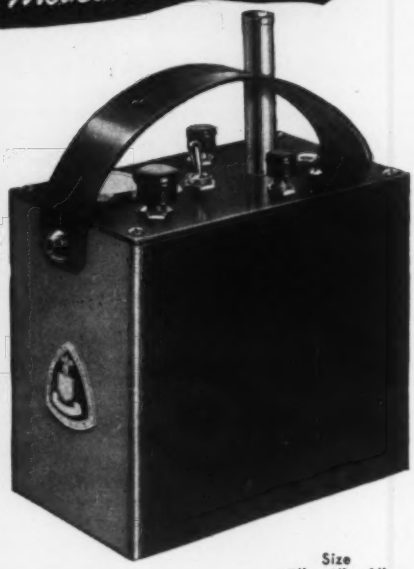
KELEKET

Model K-320

Alpha-Beta-Gamma

PORTABLE SURVEY METER





Size
7" x 4" x 9"
Wt. 4 lbs.

No other type survey-meter possesses the inherent accuracy of this instrument. Its sensitive quartz-fibre electrometer construction permits unusually accurate measurements of gamma radiation in the two ranges of 100 mr/hr and 1000 mr/hr. Will read all intensities from cosmic ray background up to 1000 mr/hr equivalent gamma radiation.

The Keleket K-320 Survey Meter is an improved version of the original Landsverk-Wollan survey-meter developed by the Manhattan District, predecessor of the U. S. Atomic Energy Commission. Incorporates a beta window of approximately 25 mg/cm^2 thickness, and a nylon window of approximately 2 mg/cm^2 for alpha measurements. This instrument is a "must" for all laboratory and personnel radioactivity monitoring procedures; and is recommended by the Interstate Commerce Commission for detection and measurement of radioactive materials handling and shipments.

1. Inherently more accurate than any electronic ionization chamber type survey meter.
2. Fibre indicator can be set to zero in the presence of radiation.
3. Easy to replace "A" battery in the field.
4. Widely used by U. S. Atomic Energy Commission laboratories.
5. Unusually rugged and dependable.

Write for literature on all Keleket instruments for radioactivity detection and measurement.

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RADIUM DETECTORS see Detectors, Radioactivity

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READING LENSES, Thermometer & Burette (See Lenses, Reading)

RECORDERS (See object of measurment and control)

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Bradley Labs.
Conant Laboratories
Control Corp.
Dearborn Scientific
De Jur-Amsco Corp.
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Mallory & Co.
Mellaphone Corp.
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Schauer Mach. Co.
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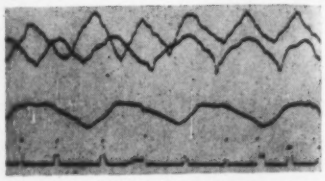

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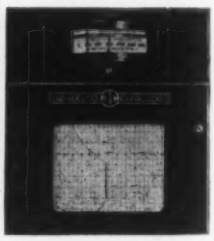

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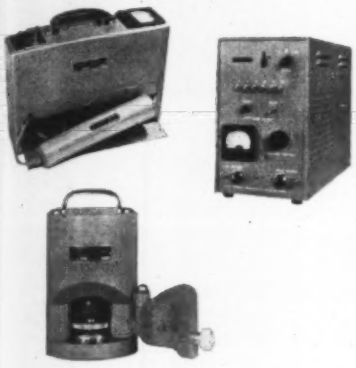

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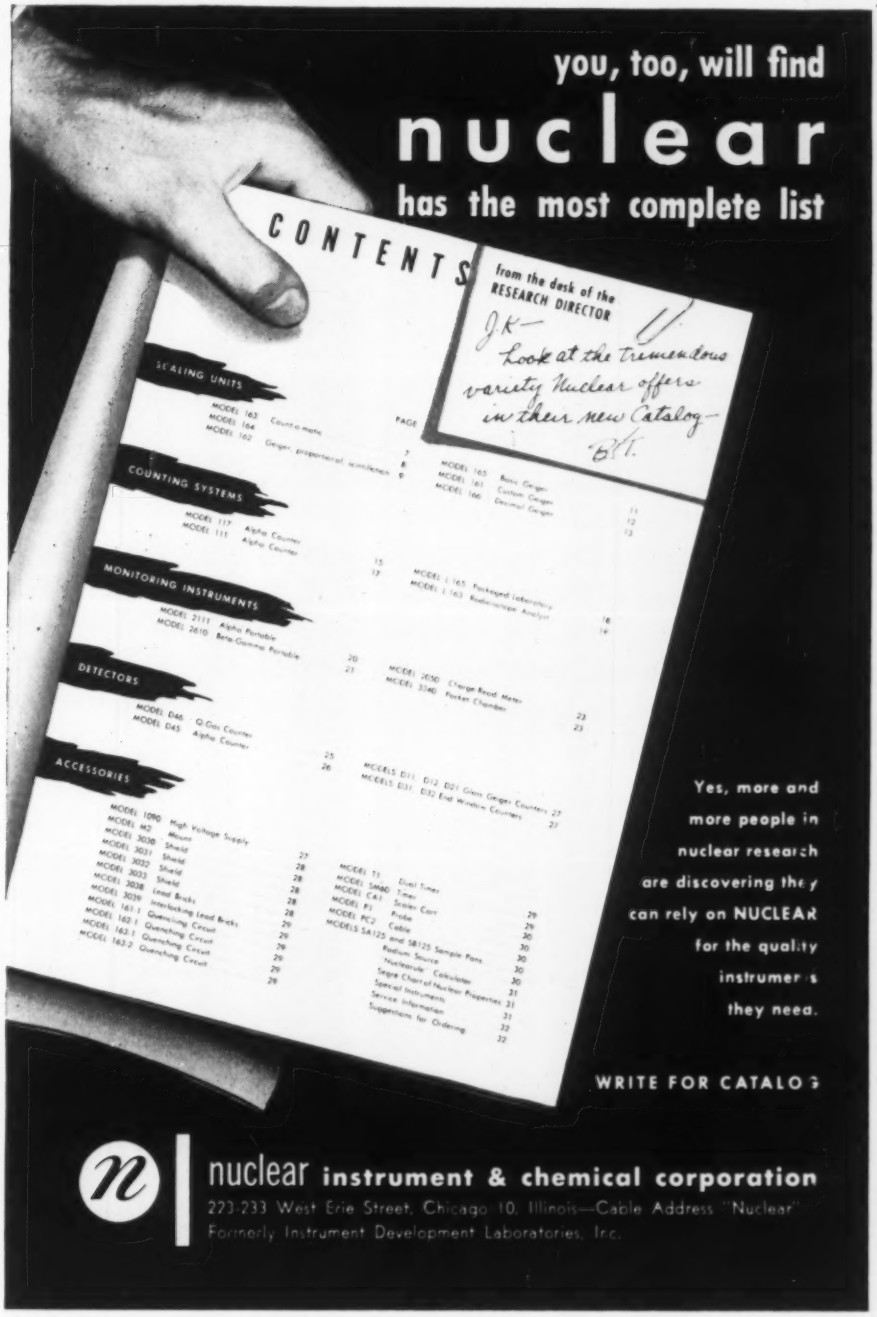
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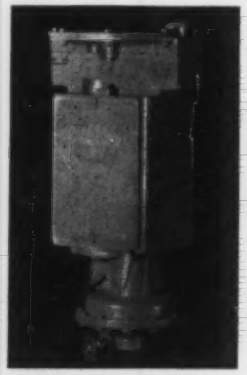

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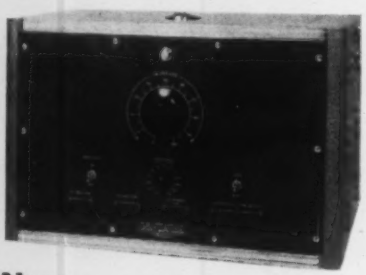

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General Controls
General Elec. Co.
H-B Instrument
Industrial Timer Corp.
Kellogg Switchboard
Leach Relay Co.
Lumenite Elec.
Miller Co., Bertrand F.
Minneapolis-Honeywell
Paragon Electric Co.
Perfex Corp.
Phillips Controls
Precision Scientific
Potter & Brumfield
Roller-Smith
Sampsel Time Control
Sigma Instrument, Inc.
Struthers-Dunn
Triplett Elec. Inst.
Ward Leonard Elec. Co.
Westinghouse Elec.
Weston Elec. Inst. Corp.

RELAYS, Continuous Current
Adams & Westlake
Advance Elec. & Relay Co.
Allen-Bradley Co.
Allied Control Co.
American Inst. Co.
Arrow-Hart & Hegeman
Autocall Co.
Automatic Elec. Chicago
Automatic Elec. Sales
Automatic Switch
Automatic Temp. Control
Clare & Co.
Cook Electric Co.
Cutler-Hammer, Inc.
Eclipse-Pioneer
General Controls
General Elec. Co.
Guardian Elec. Mfg. Co.
H-B Instrument
Industrial Timer Corp.
Kellogg Switchboard
Leach Relay Co.
Paragon Electric Co.
Potter & Brumfield
Price Electric Corp.
Sigma Instruments
Struthers-Dunn
Triplett Elec. Inst.
Ward Leonard Elec. Co.
Westinghouse Elec.
Weston Elec. Inst. Corp.

RELAYS, Control
Adams & Westlake
Advance Elec. & Relay Co.
Allen-Bradley Co.
American Inst. Co.
Amperite Co.
Autocall Co.
Automatic Elec. Chicago
Automatic Elec. Sales
Automatic Temp. Control
Bailey Meter Co.
Barber-Colman
Beck Co.
Betts & Betts
Brown Inst. Div.
B. W. Controller Corp.
Clare & Co.
Control Corp.
Cook Electric Co.
Cutler-Hammer, Inc.
Eastern Industries
Eclipse-Pioneer
Edison, Inc. Thomas
Fisher-Pierce Co.
General Controls Co.
General Elec. Co.
Guardian Elec. Mfg. Co.
Hagan Corp.
H-B Instrument
Industrial Eng. Corp.
Industrial Timer Corp.
Kellogg Switchboard
Leach Relay Co.
Miller Co., Bertrand F.
Minneapolis-Honeywell
National Time & Signal
Peyfex Corp.
Phillips Control
Photoswitch, Inc.
Potter & Brumfield
Precision Scientific
Precision Therm.
Price Electric Corp.
Robinette Co., W. C.
Roller-Smith Co.
Sampsel Time Control
Sigma Instruments
Struthers-Dunn
Triplett Elec. Inst.
Ward Leonard Elec. Co.
Westinghouse Elec.
Weston Elec. Inst. Corp.
White Rodgers Elec.

RELAYS, Current
Adams & Westlake
American Instrument
Betts & Betts
General Electric Co.
Guardian Electric
H-B Instrument
Perfex Corp.
Phillips Control
Potter & Brumfield
Roller-Smith
Sigma Instruments
Triplett Elec. Inst.
Ward Leonard
Westinghouse Elec.
Weston Elec. Inst. Corp.

RELAYS Demand Totalizing
Autocall Co.
Automatic Elec. Chicago
General Elec. Co.
Guardian Electric
Hagan Corp.
Westinghouse Elec.

RELAYS, Electromagnetic
Advance Elec. & Relay Co.
Allen-Bradley Co.
Allied Control Co.
American Inst. Co.
Amperite Co.
Arrow-Hart & Hegeman
Autocall Co.
Automatic Elec. Chicago
Automatic Elec. Mfg. Co.
Automatic Switch Co.
Bender Warrick
Bunnell & Co.
Control Corp.
Cook Electric Co.
Clare & Co.
Cutler-Hammer, Inc.
Doelcam Corp.
Eastern Industries
Eby, Inc.
Eclipse-Pioneer
Engineering Res. & Dev.
Friez Instrument Div.
General Elec. Co.
G-M Labs.
Gorrell & Gorrell
(Continued)

Guardian Elec. Mfg. Co.
H-B Instrument
Industrial Eng. Corp.
Kellogg Switchboard
Leach Relay Co.
Miller Co., Bertrand F.
Minneapolis-Honeywell
National Time & Signal
Penn Electric Switch Co.
Perfex Corp.
Phila. Thermometer Co.
Phillips Control
Potter & Brumfield
Precision Scientific
Precision Therm. & Inst.
Price Electric Corp.
Sigma Instruments, Inc.
Stromberg Time Corp.
Struthers-Dunn
Tork Clock
Triplett Elec. Inst.
Ward Leonard Elec. Co.
Warrick Co.
Westinghouse Elec.
Weston Elec. Inst. Corp.
White-Rodgers Electric

RELAYS, Electronic
Advance Elec. & Relay Co.
American Inst. Co.
Automatic Elec. Mfg.
Automatic Temp. Control
Beck Co.
Bell & Howell
Central Scientific
Clare & Co., C. P.
Coleman Electric
Cook Electric
Cramer Co., Inc.
Cutler-Hammer, Inc.
Davis & Co., Inc., Dean
Eclipse-Pioneer
Electronic Dev. Lab.
Electro-Medical Lab.
Ess Instrument
Fisher-Pierce Co.
Fisher Scientific Co.
General Elec. Co.
Gorrell & Gorrell
Guardian Elec. Mfg.
Harvey Radio Labs.
H-B Instrument
Leach Relay Co
Lumenite Co.
Lyman Electronic
Minneapolis-Honeywell
Phillips Control
Photoswitch, Inc.
Potter & Brumfield
Price Electric Corp.
Process & Instruments
RCA Div.
Robinette Co., W. C.
Sigma Instruments
Struthers-Dunn
Televiso Products
Thordarson Elec. Mfg.
Wilson & Co., G. C.

RELAYS, Frequency
Autocall Co.
Automatic Elec. Chicago
Automatic Switch Co.
Biddle Co.
Clare & Co., C. P.
Control Corp.
Cook Electric
Cutler-Hammer, Inc.
Eclipse-Pioneer
Esterline-Angus Co.
General Elec. Co.
Guardian Electric
Hickok Electrical Inst.
Kellogg Switchboard
Potter & Brumfield
Sigma Instruments
Stevens-Arnold Co.
Wallace & Tiernan
Ward Leonard Electric Co.
Westinghouse Elec.

RELAYS, Galvanometer
Assembly Products
Autocall Co.
Automatic Elec. Chicago
Automatic Temp. Control
Cole Instrument
Eby, Inc., Hugh H.
G-M Laboratories, Inc.
Potter & Brumfield
Roller-Smith
Rubicon Co.
Tagliabue Corp., C. J.

RELAYS, Heavy Duty
Adams & Westlake
Advance Elec. & Relay Co.
Allen-Bradley Co.
American Inst. Co.
Autocall Co.
Automatic Elec. Chicago
Automatic Elec. Mfg.
Automatic Switch Co.
Automatic Temp. Control
Cook Electric
Cutler-Hammer, Inc.
Eclipse-Pioneer
General Elec. Co.
H-B Instrument
Leach Relay Co.
Miller Co., Bertrand F.
Monitor Controller Co.
Philadelphia Thermometer
Potter & Brumfield
Price Electric Corp.
Struthers-Dunn
Ward Leonard Elec. Co.
Westinghouse Elec.
Weston Elec. Ints. Corp.
Zenith Electric Co.

RELAYS, Instrument Controlled
Adams & Westlake
Advance Elec. & Relay
American Inst. Co.
Assembly Products
Autocall Co.
Automatic Elec. Chicago
Automatic Elec. Mfg.
Automatic Temp. Control
Bailey Meter Co.
Barber-Colman
(Continued)

Beck Co.
Brown Inst. Div.
Carter Radio Div.
Clare & Co.
Climax Engineering
Cole Instrument
Cook Electric Co.
Cramer & Co., Inc.
Eclipse-Pioneer
Electric Dev. & Mfg.
Friez Instrument Div.
General Elec. Co.
Guardian Elec. Mfg. Co.
H-B Instrument
Minneapolis-Honeywell
Perfex Corp.
Phila. Thermometer Co.
Potter & Brumfield
Precision Scientific
Precision Therm.
Roller-Smith Co.
Sigma Instruments
Struthers-Dunn
Tagliabue Corp., C. J.
Tork Clock
Triplett Electrical Inst.
Ward Leonard Elec. Co.
Weston Elec. Inst. Corp.

RELAYS, Light Sensitive
(See Photoelectric below)

RELAYS, Magnetic
(See Relays, Electromagnetic)

RELAYS, Mercury
Adams & Westlake
American Inst. Co.
Autocall Co.
Automatic Elec. Chicago
Automatic Temp. Control
Continental Elec. Co.
Guardian Electric
H-B Instrument
Potter & Brumfield
Precision Scientific
Precision Therm.
Struthers-Dunn
Weston Elec. Inst. Corp.

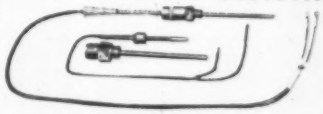
RELAYS, Mercury Tube
Adams & Westlake
American Inst. Co.
Autocall Co.
Automatic Elec. Chicago
Automatic Temp. Control
Brown Inst. Co.
Clare & Co.
General Controls Co.
G-M Labs.
Guardian Elec. Mfg. Co.
H-B Instrument
Kellogg Switchboard
Mercoid Corp.
Minneapolis-Honeywell
Phila. Thermometer
Potter & Brumfield
Precision Scientific
Precision Therm.
Struthers-Dunn
Ward Leonard Elec. Co.
Weston Elec. Inst. Corp.

EDISON

SENSITIVE **RELAYS** THERMAL

- Compact
- Shielded
- Light weight
- Polarized
- Dust and weather tight
- Explosion proof
- Tamper proof
- Non-arcing
- Ambient compensated
- Long trouble-free life

ELECTRICAL THERMOMETERS
RATIO RESISTANCE TYPE



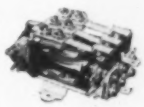
RESISTANCE BULBS
Two types: Tip-sensitive Stem-sensitive

INDICATORS
Connected by means of ordinary copper wire

OTHER EDISON INSTRUMENTS
Sealed Thermostats
Temperature Controls Temperature Monitors

INSTRUMENT DIVISION
THOMAS A. EDISON INCORPORATED
WEST ORANGE, NEW JERSEY

LINKING FUNCTION to design *with* ADVANCE RELAYS



Engineers and Designers who insist on dependable components have adapted ADVANCE RELAYS into their control circuits. They are specifying ADVANCE products, and are submitting their relay problems to us. Our expanded engineering and plant facilities, plus the recognized dependability of ADVANCE RELAYS, make it possible for us to offer the most complete line of relays for light, intermediate and heavy duty applications. Proved and Improved relay performance through ENGINEERED adaptability.

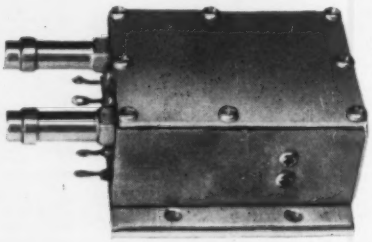
Follow the Engineers to ADVANCE RELAYS

ADVANCE ELECTRIC & RELAY CO.
1260 WEST SECOND STREET · LOS ANGELES 26, CALIFORNIA

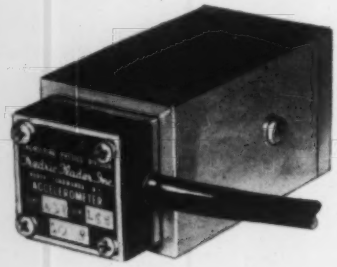
MINIATURE ELECTRICAL TRANSMITTERS

For Remote indication and recording

- **Fully temperature compensated**
- **The Most RELIABLE precision instruments employing strain gage elements ever constructed.**



- **Pressure Transmitters**
- **Accelerometers**
- **Altimeters**
- **Air Speed Transmitters**
- **Custom Instrumentation**



Specify Teleflight Instruments

Teleflight instruments offer utmost accuracy and reliability. Wide research has produced instruments with negligible hysteresis; with compensation for change in sensitivity to temperature.

Small size adapts them to important limitations of space and weight. Powered by direct current the DC output signal is sufficient for operation of recording galvanometers; by alternating current the AC output is suitable for carrier systems.

Especially designed for industrial, aircraft and missile use, Teleflight instruments have linear output over their full range and will measure both positive and negative functions over a range from −65°F. to +170°F. An individual calibration curve is supplied with each instrument after exhaustive tests.

ENGINEERING PHYSICS DIVISION

Fredric Flader, Inc.

NORTH TONAWANDA, N. Y., U. S. A.

Write for Teleflight bulletin

RELAYS, Motor Driven Time Delay
Advance Elec. & Relay Co.
Allen-Bradley Co.
American Inst. Co.
Automatic Elec. Mfg.
Barber-Colman
Betts & Betts
Clarostat Mfg. Co.
Controls, Inc.
Cramer Co., Inc.
Eagle Signal Co.
Friez Instrument
General Controls
General Electric
Guardian Electric
Haydon Co., A. W.
Industrial Eng. Corp.
Industrial Timer
Lumenite Electronics
Paragon Electric Co.
Potter & Brumfield
Price Electric Co.
Struthers-Dunn
Ward Leonard Elec. Co.
Westinghouse Elec.
Weston Elec. Inst. Corp.
Zenith Electric Co.

RELAYS, Movable Coil A.C.
Advance Elec. & Relays
Automatic Elec. Mfg.
Electro-Tech. Equip.
Esterline-Angus Co.
General Elec. Co.
Roller-Smith Co.
Triplett Elec. Inst.
Westinghouse Elec.
Weston Elec. Inst. Corp.

RELAYS, Overload
Adams & Westlake
Advance Elec. & Relay Co.
Allen-Bradley Co.
Autocall Co.
Automatic Elec. Chicago
Automatic Elec. Mfg.
Automatic Switch Co.
Automatic Temp. Control
Bunnell & Co.
Burlington Inst. Corp.
Clare & Co.
Cook Electric
Cutler-Hammer, Inc.
Edison, Instrument Div.
General Elec. Co.
(Continued)

Guardian Elec. Mfg. Co.
Leach Relay Co.
Potter & Brumfield
Price Electric Corp.
Roller-Smith Co.
Sigma Instruments
Standard Elect. Prods.
Struthers-Dunn
Ward-Leonard Elec. Co.
Westinghouse Elec.

RELAYS, Permanent Magnet Movable Coil
Assembly Products
Bunnell & Co.
Cole Instrument
Electric Des. & Mfg.
Esterline-Angus Co.
General Elec. Co.
Guardian Electric
Roller-Smith Co.
Triplett Electrical Inst.
Westinghouse Elec.
Weston Elec. Inst. Corp.

RELAYS, Photoelectric
Advance Elec. & Relay Co.
American Inst. Co.
Automatic Temp. Control
(Continued)

Autoron Co.
Clare & Co.
Continental Elec. Co.
Cutler-Hammer, Inc.
Detect-O-Ray
Dickson Co.
Eby, Inc.
Electronic Controls
Electronic Dev. Lab.
El-Tronics, Inc.
Ess Instrument Co.
Fisher-Pierce Co.
General Controls Co.
General Elec. Co.
Gorrell & Gorrell
Guardian Electric
Leach Relay Co.
Lumenite Elec.
Phillips Control
Potter & Brumfield
Potter Instrument
Photoswitch, Inc.
Precision Therm.
Rehtron Corp.
Rubicon Co.
Sigma Instruments, Inc.
Tagliabue Corp., C. J.
(Continued)

Triplett Elec. Co.
Ward Leonard Elec. Co.
Westinghouse Elec. & Mfg.
Weston Elec. Inst. Corp.

RELAYS, Polarized
Autocall Co.
Automatic Elec. Chicago
Automatic Elec. Mfg.
Barber Colman
Bunnell Co., J. H.
Eclipse-Pioneer
L. A. B. Corp.
Maxson Corp.
Miller Co., Bertrand F.
Precision Therm. & Inst.
Price Electric Corp.
Sigma Instruments
Stevens-Arnold Co.
Struthers-Dunn
Triplett Elec. Inst.
Westinghouse Elec.
Weston Elec. Inst. Corp.

RELAY, Power
Advance Elec. & Relay Co.
Allen-Bradley Co.
American Inst. Co.
Automatic Elec. Chicago
Automatic Elec. Mfg.
Automatic Switch Co.
Clare & Co.
Cutler-Hammer, Inc.
Detect-O-Ray
Eclipse-Pioneer
Esterline-Angus Co.
General Controls Co.
General Elec. Co.
Grayhill
Hagan Corp.
H-B Instrument
Leach Relay Co.
Phillips Control
Potter & Brumfield
Price Electric Corp.
Robinette Co., W. C.
Roller-Smith Co.
Struthers-Dunn
Ward Leonard Elec. Co.
Westinghouse Elec.
Weston Elec. Inst. Corp.

RELAYS, Power Factor
Advance Elec. & Relay Co.
Cutler-Hammer, Inc.
Esterline-Angus Co.
General Electric Co.
L. A. B. Corp.
Potter & Brumfield
Westinghouse Elec.

RELAYS, Resistance, D.C.
Advance Elec. & Relay Co.
Autocall Co.
Automatic Electric Chicago
Bunnell & Co.
Clare & Co., C. P.
Cook Electric Co.
Cutler-Hammer, Inc.
Esterline Angus
General Elec. Co.
Guardian Electric
Kellogg Switchboard
Leach Relay Co.
Potter & Brumfield
Price Elecgric Corp.
Sigma Instruments
Ward Leonard Elec. Co.

RELAY, Sounding
Leupold & Stevens

RELAYS, Stepping
Autocall Co.
Automatic Elec. Chicago
Automatic Elec. Sales
Clare & Co.
Collins Radio Co.
Cook Electric
General Elec. Co.
G-M Laboratories, Inc.
Guardian Electric
Roller-Smith
Struthers-Dunn
Westinghouse Elec.

RELAYS, Telephone Auxiliary Ringing
Advance Elec. & Relay Co.
Autocall Co.
Automatic Elec. Chicago
Clare & Co.
Control Corp.
Cook Electric
Federal Telephone
Guardian Electric
Kellogg Switchboard
Leach Relay Co.
Phillips Control
Potter & Brumfield
Price Electric Corp.
Sigma Instruments
Struthers-Dunn

RELAYS, Temperature
Advance Elec. & Relay Co.
Assembly Products
Autocall Co.
Automatic Temp. Control
Clare & Co., C. P.
Cole Instrument
Cook Electric Co.
Edison Elec. Controls
Friez Instrument Div.
General Controls
General Elec. Co.
Gleason-Avery, Inc.
G-M Laboratories, Inc.
Guardian Electric
H-B Instrument
Lewis Engineering
Leach Relay Co.
Minneapolis-Honeywell
Potter & Brumfield
Sampsel Time Control
Spencer Thermostat Co.
Struthers-Dunn
Tagliabue Corp., C. J.
Triplett Elec. Inst.
Westinghouse Elec.
Weston Electrical Inst.

RELAYS, Temperature Compensated
Betts & Betts
Edison, Inc., Thomas
Fuel Watchman
Guardian Electric
Sigma Instruments
Walace & Tiernan

RELAYS, Thermal Time Delay
Adams & Westlake
Advance Elec. & Relay Co.
Allen-Bradley Co.
Am. Gas Accumulator Co.
American Inst. Co.
Amperite Corp.
Autocall Co.
Automatic Elec. Chicago
Automatic Elec. Mfg. Co.
Automatic Temp. Control
Betts & Betts
Clare & Co.
Clarostat Mfg. Co.
Cook Electric Co.
Cramer Co., Inc.
Cutler-Hammer, Inc.
Eagle Signal Corp.
Edison, Inc., Thomas
Electronic Prod. Co.
Fisher-Pierce Co.
General Controls
General Elec. Co.
Guardian Elec. Mfg. Co.
Industrial Eng. Corp.
Industrial Timer Corp.
Leach Relay Co.
Lumenite Electronics
Magnetic Gauge Co.
Meletron Corp.
Paragon Electric Co.
Partlow Corp.
Perfex Corp.
Potter & Brumfield
Precision Therm.
Preferred Utilities Mfg. Co.
Roller-Smith Co.
Sigma Instruments
Struthers-Dunn
Ulanet Co., Geo.
Ward Leonard Elec. Co.
Weston Elec. Inst. Corp.
Westinghouse Elec.
White-Rodgers Electric

RELAYS, Time Delay (See **Relays, Thermal Time Delay**)

RELAYS, Transformer (Low Voltage)
Advance Elec. & Relay Co.
Allen-Bradley Co.
Auth Elec. Spec.
Automatic Electric Chicago
Barber-Colman
B. W. Controller Corp.
Friez Instrument Div.
General Controls Co.
General Elec. Co.
Gleason-Avey, Inc.
Guardian Elec. Mfg. Co.
H-B Electric
Industrial Eng. Corp.
Lumenite Electronics
Mercoid Corp.
Miller Co., Bertrand F.
Minneapolis-Honeywell
Paragon Electric Co.
Partlow Corp.
Perfex Corp.
Potter & Brumfield
Sampsel Time Control
Sigma Instruments, Inc.
Struthers-Dunn
Thordarson Elec. Mfg.
Ward Leonard
Warrick Co.
Westinghouse Elec.
White-Rodgers Electric

RELAYS, Vacuum Contact
American Inst. Co.
Edison, Inc., Thomas
General Elec. Co.
H-B Instrument
Lumenite Electronics
Skaneateles Mfg. Co.
Struthers-Dunn, Inc.

RELAYS, Vacuum Tube
Advance Elec. & Relay Co.
American Inst. Co.
Amperite Co.
Automatic Elec. Mfg.
Automatic Temp. Control
Continental Elec. Co.
Eby, Inc.
Eclipse-Pioneer
Edison, Inc., Thomas
Electro-Medical Lab.
Electronic Dev. Lab.
Electronic Prod. Co.
El-Tronics, Inc.
Fisher-Pierce Co.
General Controls Co.
General Elec. Co.
Harvey Radio Labs.
H-B Instrument
Kellogg Switchboard
L. A. B. Corp.
Leach Relay Co.
Lumenite Electronics
Metron Instrument
Precision Therm.
Robinette Co., W. C.
Sigma Instruments
Skaneateles Mfg. Co.
Struthers-Dunn
Sylvania Elec. Prods.
Tagliabue Corp., C. J.
Wilson & Co.

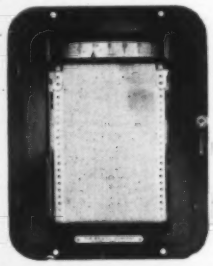
RELAYS, Voltage
Adams & Westlake
Advance Elec. & Relay
Allen-Bradley Co.
Amperite Co.
Autocall Co.
Automatic Elec. Chicago
Automatic Elec. Mfg.
Automatic Switch Co.
Barber-Colman
Clare & Co., C. P.
Cook Electric
Cutler-Hammer, Inc.
Eby, Inc., Hugh H.
Eclipse-Pioneer
Esterline-Angus Co.
Ferranti Electric, Inc.
General Controls
General Elec. Co.
Guardian Electric
(Continued)

BRISTOL'S

EXCLUSIVE

METAMETER

Telemetering — Remote measurement and automatic control



SERIES 500 RECEIVER

Bristol's Metameter System of Telemetering gives an accurate, up-to-the-minute account of conditions at remote points . . . enables you to anticipate abnormalities . . . prevent them from developing into emergencies. Measures pressure, flow, temperature, liquid level, motion and gate position, voltage, current power, totalized power load, and reactive volt amperes. The impulse-duration principle on which the Bristol Metameter works gives you the further advantage of a choice of transmitting media: carrier channel . . . simple two-wire circuit . . . radio beam . . . or any convenient circuit you may select.

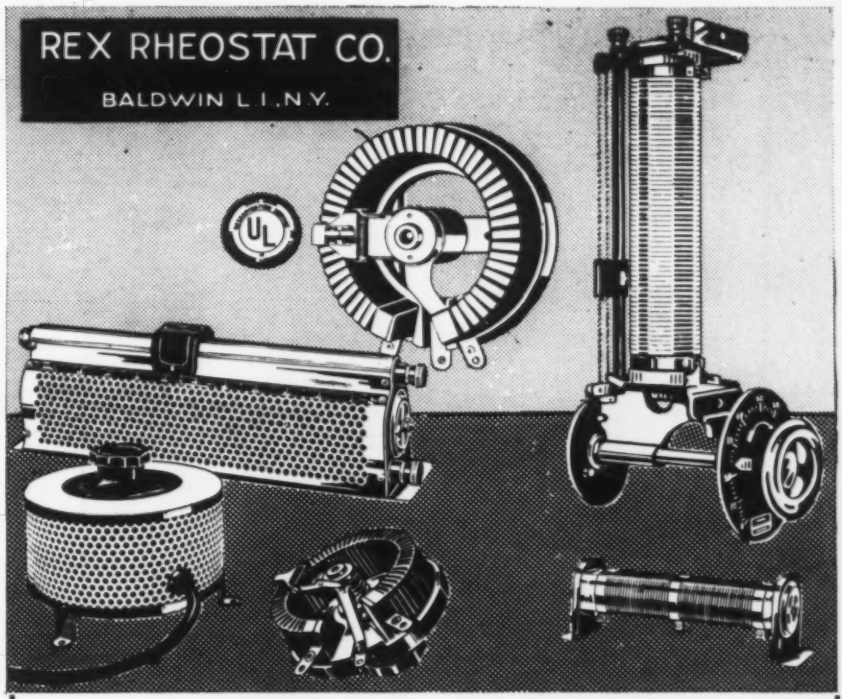
ALSO: REMOTE AUTOMATIC CONTROL.

THE BRISTOL COMPANY

113 BRISTOL ROAD, WATERBURY 91, CONN.

REX RHEOSTAT CO.

BALDWIN L.I., N.Y.



TUBULAR SLIDE-CONTACT RHEOSTATS with *SELF-LUBRICATING FLOATING CONTACT ELEMENT*

• Protected and Unprotected Types • Easy and accurate adjustment.

VITREOUS ENAMELED ROUND POWER RHEOSTATS with *SPRING-HINGED CONTACT ARM* • 7 Types • 50 to 500 Watt.

UL APPROVED • With and without Housing • Permanent smooth action.

Hart Manufacturing Co.
Hathaway Inst. Co.
Leach Relay Co.
Lumenite Electronic
Philips Control
Potter & Brumfield
Reliance Instrument Co.
Roller-Smith Co.
Sigma Instruments
Struthers Dunn, Inc.
Sylvania Elec. Prod.
Triplett Electrical Inst.
Ward Leonard Elec. Co.
Westinghouse Elec.
Weston Electrical Inst.

REMOTE - METERING EQUIPMENT, ELECTRICAL

Ace Instrument Co.
American Temp. Ind.
Automatic Temp. Control
Bristol Co.
Brooks Rotameter
Brown Inst. Div.
Builders-Providence
Clarke Inst. Corp.
Cole Instrument
Control Corp.
Elec. Tachometer Corp.
Electronic Associates
Esterline-Angus Co.
Farnsworth Television
Federal Telephone
Fischer & Porter
Flader, Inc., Fredric
Foxboro Co.
General Elec. Co.
W. & L. E. Gurley
Hagan Corp.
Hathaway Inst. Co.
Hays Corp.
H & H Thermostats
Jacobs Instruments
Kellogg Switchboard
Kollsman Inst. Div.
L. A. B. Corp.
Landis & Gyr
Leeds & Northrup Co.
Leukurt Electric Co.
Martin-Hubbard Corp.
Mason-Neilan Regulator
Moisture Register Co.
Moore Products
Panoramic Radio Co.
Penn Ind. Inst. Co.
Pioneer Instrument
Polarad Electronics
Republic Flow Meters
Revere Corp.
Rosen Engg. Products
Schaevitz Eng.
Servo Corp. of America
Sherron Metallic
Skaneateles Mfg. Co.

(Continued)

Statham Labs.
Tagliabue Corp., C. J.
Van Dyke Instruments
Vapor Recovery Systems
Westinghouse Elec.
Wilson & Co.
Yardeny Engineering

REMOTE - METERING EQUIPMENT, HYDRAULIC

Automatic Temp. Control
Builders-Providence
Emery Co., A. H.
Farris Engg. Corp.
Leupold & Stevens
Mason-Neilan Regulator
Servo Corp. of America
Skaneateles Mfg. Co.
Smith Meter Co.
Westinghouse Elec.

REMOTE-METERING EQUIPMENT, Pneumatic

American Meter Co.
Automatic Temp. Control
Bristol Co.
Brooks Rotameter
Brown Inst. Div.
Builders-Providence
Conoflow Corp.
Emery Co., A. H.
Farris Engg. Corp.
Fischer & Porter
Foxboro Co.
Hagan Corp.
Haydon Co., A. W.
Mason-Neilan Regulator
Moore Products
Republic Flow Meters
Servo Corp. of America
Taylor Inst. Cos.

RESISTANCE LOADING EQUIPMENT

Cole Instrument
De Jur-Amsco
Eastern Specialty Co.
General Elec. Co.
Hardwick, Hindle, Inc.
International Resistance
Precision Resistor Co.
Shallcross Mfg.
Ward Leonard

RESISTANCES

Aerovox Corp.
Allen-Bradley Co.
Associated Research
Automatic Elec. Chicago
Beck Bros.
Central Scientific Co.
Clarostat Mfg. Co.
Cutler-Hammer, Inc.
Daven Co.
Electronic Dev. Lab.
General Elec. Co.
General Radio Co.
Gray Instrument

(Continued)

Instrument Resistors
International Resistance
Leeds & Northrup
Mallory & Co.
Ohmite Mfg. Co.
Precision Resistor Co.
Resistance Products
Rubicon Co.
Sensitive Research Inst.
Shallcross Mfg. Co.
Van Dyke Instruments
Ward Leonard
Westinghouse Elec.

RESISTORS, Adjustable

Aerovox Corp.
Allen-Bradley Co.
Carter Parts Div.
Clarostat Mfg. Co.
Cutler-Hammer, Inc.
Daven Co.
De Jur-Amsco
General Radio Co.
Hardwick, Hinde, Inc.
Instrument Resistors Co.
International Resistance
Lectrohm Inc.
Leeds & Northrup
Lewis Engineering
Mallory & Co.
Model Engineering
Ohmite Mfg. Co.
Resistors, Inc.
Rex Rheostat Co.
Sticht Co.
Technology Instrument
Van Dyke Instrument
Walker-Jimieson, Inc.
Ward Leonard Electric Co.
Westinghouse Elec.

RESISTORS, Carbon Compression

Allen-Bradley Co.
Beck Bros.
Eastern Specialty Co.
Eclipse-Pioneer Div.
Jas. G. Biddle Co.
Instrument Resistors
Keystone Carbon
Natl. Carbon Co., Inc.
Ohio Carbon Co.
Speer Carbon Co.
Welch Mfg. Co.

RESISTORS, High Frequency

Beck Bros.
Clarke Inst. Corp.
Corning Glass Works
Daven Co.
Erie Resistor Corp.
General Elec. Co.
General Radio Co.
Hardwick, Hindle, Inc.
Instrument Resistors Co.
International Resistance
Leeds & Northrup Co.

(Continued)

Madison Elec. Prod. Div.
Mallory & Co.
Measurements Corp.
Ohmite Mfg. Co.
Resistance Products Co.
Shallcross Mfg. Co.
Technology Instrument
Ward Leonard Elec. Co.
Welwyn Electronic

RESISTORS, High Voltage

Associated Research
Beck Bros.
Clarostat Mfg. Co.
Cole Instrument
Cutler-Hammer, Inc.
General Elec. Co.
Hardwick, Hindle, Inc.
Instrument Resistors Co.
International Resistance
J B L Instrument Co.
Madison Elec. Prod. Div.
Ohmite Mfg. Co.
Reiner Electronics
Resistance Products Co.
Sensitive Research Inst.
Shallcross Mfg. Co.
Simpson Electric Co.
Ward Leonard Electric Co.
Westinghouse Elec.
Weston Elec. Inst. Corp.

RESISTORS, Manganin

Associated Research
Beck Bros.
Cole Instrument
Daven Co.
De Jur-Amsco
Electronic Dev. Lab.
Federal Instrument
General Radio Co.
Gray Instrument Co.
Hardwick, Hindle, Inc.
Instrument Resistors Co.
Leeds & Northrup Co.
Madison Elec. Prod. Div.
Ohmite Mfg. Co.
Radio City Products
Reiner Electronics
Resistance Products Co.
Rubicon Co.
Sensitive Research Inst.
Shallcross Mfg. Co.
Van Dyke Instruments
Westinghouse Elec.

RESISTORS, Molded

Aerovox Corp.
Allen-Bradley Co.
Beck Bros.
Clarostat Mfg. Co.
Erie Resistor Corp.
General Elec. Co.
Instrument Resistor Co.
International Resistance
Ohmite Mfg. Co.
Radio City Products
Reiner Electronics
Westinghouse Elec.

RESISTORS, Standard (See Standards, Resistance)

RESISTORS, Variable

Aerovox Corp.
Allen Bradley Co.
Beck Bros.
Jas. G. Biddle Co.
Centralab Div.
Clarostat Mfg. Co.
Cutler-Hammer, Inc.
Daven Co.
De Jur-Amsco
Federal Instrument
Ford Engineering
General Elec. Co.
General Radio Co.
Gray Instrument Co.
Hardwick, Hindle, Inc.
Helipot Corp.
Instrument Resistors Co.
International Resistance
Lectohm, Inc.
Leeds & Northrup Co.
Lewis Engineering
Mallory & Co.
Muter Co.
Natl. Elec. Controller
Ohmite Mfg. Co.
Resistors, Inc.
Rex Rheostat Co.
Rubicon Co.
Shallcross Mfg.
Sticht Co.
Technology Instrument
Van Dyke Instruments
Ward Leonard Electric

RESISTORS, Wire Wound

Aerovox Corp.
Associated Research
Automatic Elec. Chicago
Beck Bros.
Biddle Co., Jas. G.
Carter Parts Div.
Clarostat Mfg. Co.
Cole Instrument
Cutler-Hammer, Inc.
Daven Co.
De Jur-Amsco
Electro-Tech. Equip.
Federal Instrument
General Elec. Co.
General Radio Co.
Gray Instrument Co.
Hardwick, Hindle, Inc.
Instrument Resistors Co.
International Resistance
Lectrohm, Inc.
Leeds & Northrup Co.
Madison Elec. Prod. Div.
Mallory & Co.
Model Engineering
Muter Co.

(Continued)

National Electric Control
Ohmite Mfg. Co.
Resistance Prod. Co.
Resistors, Inc.
Rex Rheostat Co.
Rubicon Co.
Shallcross Mfg. Co.
Simpson Electric Co.
Sticht Co.
Technology Instrument
Van Dyke Instruments
Ward Leonard Electric Co.
Welwyn Electronic
Westinghouse Elec.
Weston Elec. Inst. Corp.

RHEOSTATS, Battery Charging

Allen-Bradley Co.
Beck Bros.
Centralab Div.
Clarostat Mfg. Co.
Cutler-Hammer, Inc.
De Jur-Amsco
Hardwick, Hindle, Inc.
International Resistance
Natl. Elec. Controller
Ohmite Mfg. Co.
Rex Rheostat Co.
Ward Leonard Elec. Co.

RHEOSTATS, Field

Cutler-Hammer, Inc.
General Electric Co.
Ohmite Mfg. Co.
Ward Leonard Elec. Co.

RHEOSTATS, Laboratory

Allen-Bradley Co.
American Inst. Co.
Beck Bros.
Biddle Co., Jas. G.
Centralab Div.
Cole Instrument
De Jur-Amsco Corp.
Ford Engineering
Central Scientific Co.
Centralab Div.
Chicago Apparatus Co.
Clarostat Mfg. Co.
Daven Company
Eastern Specialty Co.
Electronic Associates
General Radio Co.
G-M Labs.
Gray Instrument Co.
Hardwick, Hindle, Inc.
Helipot Corp.
International Resistance
Mallory & Co.
Natl. Elec. Controller
National Tech. Labs.
Ohmite Mfg. Co.
Rex Rheostat Co.
Rubicon Co.
Schaefer Bros. Co.
Sticht Co.

(Continued)

Technology Instrument
Thwing-Albert Inst. Co.
Van Dyke Instruments
Ward-Leonard Elec. Co.

RHEOSTATS, Meter Testing
Allen-Bradley Co.
Beer Bros.
Biddle Co., Jas. G.
Clarostat Mfg. Co.
Cole Instrument
Daven Co.
De Jur-Amsco Corp.
Eastern Specialty Co.
Gray Instrument Co.
International Resistance
Leeds & Northrup
Mallory & Co.
Natl. Elec. Controller
Ohmite Mfg. Co.
Rex Rheostat Co.
Shallcross Mfg.
States Co.
Ward Leonard Elec. Co.

RHEOSTATS, Slide Wire
Beck Bros.
Biddle Co., Jas. G.
Central Scientific Co.
Chicago Apparatus Co.
Clarostat Mfg. Co.
Cole Instrument
Cutler-Hammer, Inc.
Ford Engineering
General Radio Co.
Gray Instrument Co.
Hardwick, Hindle, Inc.
Helipot Corp.
Leeds & Northrup
Natl. Elec. Controller
National Tech. Labs.
Ohmite Mfg. Co.
Rex Rheostat Co.
Rubicon Co.
Shallcross Mfg. Co.
Stiefel Co.
Technology Instrument
Thwing-Albert Inst. Co.
Van Dyke Instruments
Welch Scientific

RIDEOMETERS, RIDE COMFORT Recorder & Riding-Quality Instruments
Calidyne Co.
Commercial Research
Impact Register Co.
Jaeger Watch Co.
Saxl Instrument
Sperry Products, Inc.

ROTAMETERS (See Flowmeters, Area, Free Float Type)

RUBBER STOPPERS
Rhodes Metaline Co.

RULES, Adjustable Curve (See Drawing Instruments)

RULES, Aluminum
Bowen & Co.
Keuffel & Esser Co.
Lufkin Rule Co.
Warren-Knight Co.

RULES, Brass
Bliss & Co.
Grammes & Sons
Lufkin Rule Co.
Mico Instrument Co.
Starrett Co.
Warren-Knight Co.

RULES, Caliper
American Measuring Inst.
Brown & Sharpe
Glogau & Co.
Lufkin Rule Co.
Millers Falls Co.
Starrett Co.
Union Tool Co.
Warren-Knight Co.

RULES, Drafting Room (See Drawing Instruments)

RULES, Folding
Bliss & Co.
Dietzgen Co.
Keuffel & Esser Co.
Lufkin Rule Co.
Post Co., Frederick
Speidel & Co.
Starrett Co.
Warren-Knight Co.
Weber Co.
White Co., David

RULES, Glass
Fish-Schurman Co.
Dusenberry Co.
Electronic Products
Engineers Specialty Div.
Glass Engraving Co.
Kontes Glass Co.
Mico Instrument Co.
Palos Optical Co.
Phoenix Prec. Inst.
Scientific Glass App.

RULES, Parallel
American Meas. Insts.
Bliss & Co.
Dietzgen Co.
Hamilton Mfg. Co.
Keuffel & Esser Co.
Lufkin Rule Co.
Negus, T. S. & J. D.
Palos Optical Co.
Speidel & Co.
Warren-Knight Co.
White Co., Inc.
Weber Co.

RULES, Precision Standard
Amer. Measuring Insts.
Bowen & Co.
Brown & Sharpe
Engineers Specialty Div.
Gaertner Scientific Corp.
Griswold Mfg. Co.
Lufkin Rule Co.
Starrett Co.

RULES, Shrinkage
Brown & Sharpe
Keuffel & Esser Co.
Lufkin Rule Co.
Speidel & Co.
(Continued)

Starrett Co.
Warren-Knight Co.
Weber Co.

RULES, Slide (See Drawing Instruments)

RULES, Steel
American Measuring Insts.
Bowen & Co.
Brown & Sharpe
Keuffel & Esser Co.
Lufkin Rule Co.
Mico Instrument Co.
Millers Falls Co.
Scherr Co., Inc.
Speidel & Co.
Starrett Co.
Union Tool Co.
Warren-Knight Co.
Weber Co.

RULES, Wood
Henschel & Co.
Keuffel & Esser Co.
Lufkin Rule Co.
Post Co., Frederick
Speidel & Co.
Warren-Knight Co.
Weber Co.

RUNNING TIME RECORDERS
Alden Products
American Time Prod.
Bristol Co.
Cincinnati Time Rec.
Cramer Co., Inc.
Gorrell & Gorrell
Marion Electrical Inst.
Westinghouse Elec.

RUNNING TIME TOTALIZERS
Bristol Co.
Cincinnati Time Rec.
Cramer Co., Inc.
Dale Instruments
Elec. Tachometer Corp.
Gorrell & Gorrell
Haydon Co., A. W.
Jaeger Watch Co.
Lumenite Electronic
Production Instrument
Serdex, Inc.
Standard Elec. Time

SACCHARIMETERS
Aloe Co., A. S.
Bausch & Lomb Opt.
Central Scientific Co.
Griebel Co.
Jarrell-Ash Co.
Kimble Glass
Moeller Instrument Co.
Precision Thermometer
Rieker Inst. Co.
Rudolph & Sons
Sargent & Co.
Trerice Co.
Weksler Thermometer

SACCHAROMETERS
Central Scientific Co.
Fleischhauer & Son
Griebel Co.
G. M. Mfg. Co., Inc.
H. B. Inst. Co.
Kimble Glass Co.
Moeller Instrument Co.
Precision Therm. & Inst.
Rascher & Betzold
Rieker Inst. Co.
Ruehfel Co.
Scientific Inst. Co.
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Testrite Instrument Co.
Trerice Co.
Wagner & Son
Weksler Thermometer

SALINITY INDICATORS
Bendix Marine Products
Central Scientific Co.
Engineering Labs., Inc.
Fleischhauer & Son
G. M. Mfg. Co., Inc.
Griebel Co.
H-B Inst. Co.
Industrial Insts., Inc.
Instrument Lab.
J-B-L Instrument
Leeds & Northrup Co.
Moeller Inst. Co.
Precision Therm. & Inst.
Rascher & Betzold
Rubicon Co.
Ruehfel Co.
Scientific Inst. Co.
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Thwing Albert Inst. Co.
Trerice Co.
Weksler Thermometer
Wagner & Son
Westinghouse Elec.

SALINOMETERS (See Salinity Indicators)

SAMPLER, Boiler Water
Hagan Corp.
Tagliabue Corp., C. J.

SAMPLER, Oil
Braun Corp.
Central Scientific Co.
Hoke, Inc.
Johnston & Jennings Co.
Precision Scientific
Proportioneers, Inc.
Refinery Supply Co.
Scientific Glass Apparatus
Shand & Jurs
Vapor Recovery Systems

SAMPLERS, Oil Bottom-hole
Coleman Inst. & Mfg.
Hoke, Inc.
Precision Scientific
Ruska Inst. Corp.

SAMPLERS, Sewage
Builders-Providence
Central Scientific Co.
Precision Scientific
Scientific Glass Apparatus
Thwing-Albert Inst.

SAMPLERS, Silt
Central Scientific Co.
Instruments Corp.
Leupold & Stevens

SAMPLERS, Snow
Leupold & Stevens

SCALES (See also object of Measurement and Control)

SCALES, Antimony Test
Howe Scale Co.
Seederer-Kohlbusch, Inc.
Troemner, Henry

SCALES, Automatic
Automatic Scale Co.
Buffalo Scale Co.
Chatillon & Sons
Exact Weight Scale
Fairbanks, Morse & Co.
Gump Co.
Howe Scale Co.
International Bus. Mach.
Jacobs Bros. Co., Inc.
Merrick Scale Mfg. Co.
Porter, George K.
Richardson Scale Co.
Schaffer Poidometer Co.
Seedburo Equipment
Streeter-Amet Co.
Toledo Scale Co.
Triner Sales Co.
Yale & Towne Mfg. Co.
Wallace & Tiernan

SCALES, Bag Filling
Automatic Scale Co.
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Gump Co.
Howe Scale Co.
Jacobs Bros. Co.
Richardson Scale Co.
Seedburo Equipment
Toledo Scale Co.
Yale & Towne Mfg.

SCALES, Basis Weight
Amthor Testing Inst. Co.
Becker Div., Christian
Buffalo Scale Co.
Cady & Co., E. J.
Exact Scale Co.
Howe Scale Co.
Seederer-Kohlbusch
Testing Machines, Inc.
Thwing-Albert Instrument
Toledo Scale Co.
Triner Sales Co.
Yale & Towne Mfg.

SCALES, Bulk Weighing
Automatic Scale
Becker Div., Christian
Buffalo Scale Co.
Chatillon & Sons
Conoflow Corp.
Emery Co., A. H.
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Gump Co., B. F.
Howe Scale Co.
Jacobs Bros. Co.
Merrick Scale Mfg.
Richardson Scale Co.
Schaffer Poidometer Co.
Streeter-Amet Co.
Toledo Scale Co.
Triangle Package Mach.
Triner Sales Co.
Troemner, Henry
Yale & Towne Mfg.

SCALES, Cement Batching
Buffalo Scale Co.
Chatillon & Sons
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Howe Scale Co.
Richardson Scale Co.
Streeter-Amet Co.
Toledo Scale Co.
Triner Sales Co.

SCALES, Checking
Becker Div., Christian
Buffalo Scale Co.
Chatillon & Sons
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Howe Scale Co.
Jacobs Bros. Co., Inc.
Merrick Scale Mfg. Co.
Richardson Scale Co.
Toledo Scale Co.
Triner Sales Co.
Yale & Towne Mfg.

SCALES, Classifying
Chatillon & Sons
Exact Weight Scale Co.
Jacobs Bros. Co., Inc.
Merrick Scale Mfg. Co.
Toledo Scale Co.
Triner Sales Co.
Yale & Towne Mfg.

SCALES, Computing
Amthor Testing Inst.
Exact Weight Scale
Howe Scale Co.
International Bus. Mach.
Jacobs Bros., Inc.
Toledo Scale Co.
Triner Sales Co.
Yale & Towne Mfg.

SCALES, Continuous Weighing
Automatic Scale
Buffalo Scale Co.
Builders-Providence
Chatillon & Sons
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Gump Co.
Jacobs Bros. Co.
Jeffrey Mfg. Co.
Merrick Scale Mfg. Co.
Omega Machine
Richardson Scale Co.
Schaffer Poidometer Co.
Streeter-Amet Co.
Toledo Scale Co.
Triangle Package Mach.
Wallace & Tiernan

SCALES, Conveyor
Builders-Providence
Chatillon & Sons
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Howe Scale Co.
International Bus. Mach.
Merrick Scale Mfg. Co.
Omega Machine
Richardson Scale Co.
Schaffer Poidometer Co.
Streeter-Amet Co.
Toledo Scale Co.
Wallace & Tiernan
Yale & Towne Mfg.

SCALES, Counting
Amthor Testing Inst. Co.
Buffalo Scale Co.
Chatillon & Sons
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Howe Scale Co.
International Bus. Mach.
Jacobs Bros. Co.
Potter Instrument
Seederer-Kohlbusch
Toledo Scale Co.
Triner Sales Co.
Yale & Towne Mfg.

SCALES, Crane
Baldwin Locomotive
Buffalo Scale Co.
Chatillon & Sons
Dillon & Co.
Emery Co., A. H.
Fairbanks, Morse & Co.
Howe Scale Co.
Toledo Scale Co.
Yale & Towne Mfg.

SCALES, Dairy
Becker Div., Christian
Buffalo Scale Co.
Central Scientific Co.
Chatillon & Sons
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Howe Scale Co.
Humboldt Mfg. Co.
International Bus. Mach.
Jacobs Bros. Co.
Streeter-Amet Co.
Toledo Scale Co.
Triner Sales Co.
Troemner, Henry
Yale & Towne Mfg.

SCALES, Differential
Chatillon & Sons
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Jacobs Bros. Co., Inc.
Thwing-Albert Instrument

SCALES, Drawing (See Drawing Instruments)

SCALES, Dump
Automatic Scale
Buffalo Scale Co.
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Howe Scale Co.
Toledo Scale Co.

SCALES, Dynamometer
Automatic Temp. Control
Baldwin Locomotive
Central Scientific Co.
Chatillon & Sons
Conoflow Corp.
Dillon & Co.
Emery Co., A. H.
Exact Weight Scale
Fairbanks, Morse & Co.
Hagan Corp.
Howe Scale Co.
Republic Flow Meters
Seederer-Kohlbusch, Inc.
Stoelting Co., C. N.
Taller & Cooper
Toledo Scale Co.
Yale & Towne Mfg.

SCALES, Estimating
Exact Weight Scale Co.
Jacobs Bros. Co.
Seederer-Kohlbusch, Inc.
Troemner, Henry

SCALES, Grain & Seed Testing
Amthor Testing Inst. Co.
Automatic Scale Co.
Becker Div., Christian
Buffalo Scale Co.
Central Scientific Co.
Chatillon & Sons
Cuthbert Co.
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Fisher Scientific Co.
Gump Co.
Howe Scale Co.
Jacobs Bros. Co.
Richardson Scale Co.
Seedburo Equipment
Streeter-Amet Co.
Toledo Scale Co.
Triangle Package Mach.
Triner Sales Co.
Troemner, Henry

SCALES, Hopper
Buffalo Scale Co.
Chatillon & Sons
Exact Weight Scale
Fairbanks, Morse & Co.
Gump Co.
Howe Scale Co.
Jacobs Bros. Co.
Richardson Scale Co.
Seedburo Equipment
Streeter-Amet Co.
Toledo Scale Co.
Yale & Towne Mfg.

SCALES, Laboratory
Becker Div., Christian
Buffalo Scale Co.
Central Scientific Co.
Chatillon & Sons
Chicago Apparatus Co.
Clay-Adams Co.
Dietert Co.
Eberbach & Son
Exact Weight Scale Co.
Fairbanks, Morse & Co.
(Continued)

Fisher-Scientific Co.
Goetze Niemer Co.
Howe Scale Co.
Humboldt Mfg. Co.
International Bus. Mach.
Jacobs Bros. Co.
Microchemical Service
Seedburo Equipment
Seederer-Kohlbusch, Inc.
Thompson Balance
Toledo Scale Co.
Troemner, Henry
Voland & Sons

SCALES, Larry Car
Buffalo Scale Co.
Fairbanks, Morse & Co.
Howe Scale Co.
Richardson Scale Co.
Streeter-Amet Co.
Toledo Scale Co.
Yale & Towne Mfg.

SCALES, Liquid
Exact Weight Scale Co.
Howe Scale Co.
Jacobs Bros. Co., Inc.
Merrick Scale Mfg.
Richardson Scale Co.
Toledo Scale Co.
Yale & Towne Mfg.

SCALES, Loss of Weight
Becker Div., Christian
Buffalo Scale Co.
Builders-Providence
Dietert Co.
Exact Weight Scale Co.
Jacobs Bros. Co.
Omega Machine
Proportioneers, Inc.
Seederer-Kohlbusch, Inc.
Streeter-Amet Co.
Thwing-Albert Inst.
Toledo Scale Co.

SCALES, Mud
Chatillon & Sons

SCALES, Over & Under
Automatic Scale
Becker Div., Christian
Buffalo Scale Co.
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Howe Scale Co.
International Bus. Mach.
Jacobs Bros. Co.
Moisture Register Co.
Seedburo Equipment
Streeter-Amet. Co.
Toledo Scale Co.
Triner Sales Co.
Troemner, Henry

SCALES, Packaging
Automatic Scale Co.
Chatillon & Sons
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Gump Co.
Howe Scale Co.
International Bus. Mach.
Jacobs Bros. Co.
Richardson Scale Co.
Toledo Scale Co.
Triangle Package Mach.
Triner Sales Co.
Troemner, Henry

SCALES, Platform
Becker Div., Christian
Buffalo Scale Co.
Chatillon & Sons
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Gump Co.
Howe Scale Co.
Humboldt Mfg. Co.
International Bus. Mach.
Seedburo Equipment
Streeter-Amet Co.
Toledo Scale Co.
Triner Sales Co.
Yale & Towne Mfg.

SCALES, Portable
Black & Decker
Buffalo Scale Co.
Central Scientific Co.
Chatillon & Sons
Dillon & Co.
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Gump Co.
Howe Scale Co.
International Bus. Mach.
Jacobs Bros. Co.
Kron Co.
Richardson Scale Co.
Seedburo Equipment
Streeter-Amet Co.
Toledo Scale Co.
Triner Sales Co.
Voland & Sons
Yale & Towne Mfg.

SCALES, Predetermined Weight
Automatic Scale
Buffalo Scale Co.
Exact Weight Scale Co.
Fairbanks, Morse, & Co.
Gump Co.
Howe Scale Co.
International Bus. Mach.
Jacobs Bros. Co.
Merrick Scale Mfg. Co.
Richardson Scale Co.
Schaffer-Poidometer Co.
Seederer-Kohlbusch, Inc.
Streeter-Amet Co.
Toledo Scale Co.
Triner Sales Co.
Yale & Towne Mfg.

SCALES, Recording
Automatic Temp. Control
Buffalo Scale Co.
Fairbanks, Morse & Co.
Hagan Corp.
Howe Scale Co.
Merrick Scale Mfg. Co.
Richardson Scale Co.
Streeter-Amet Co.
Taller & Cooper
Toledo Scale Co.
Wallace & Tiernan
Yale & Towne Mfg.

SCALES, Remote Indicating
Automatic Temp. Control
Conoflow Corp.
Dillon & Co.
Emery Co., A. H.
Exact Weight Scale Co.
Howe Scale Co.
Merrick Scale Mfg.
Republic Flow Meters
Streeter-Amet Co.
Taller & Cooper
Toledo Scale Co.
Yale & Towne Mfg.

SCALES, Rolling Mill
Buffalo Scale Co.
Fairbanks, Morse & Co.
Howe Scale Co.
Streeter-Amet Co.
Toledo Scale Co.
Yale & Towne Mfg.

SCALES, Sacking See **Scales, Bag-Filling**

SCALES, Selecting
Exact Weight Scale Co.
Howe Scale Co.
Merrick Scale Mfg.
Toledo Scale Co.
Yale & Towne Mfg.

SCALES, Solder Test
Central Scientific Co.
Exact Weight Scale
Seederer-Kohlbusch, Inc.
Troemner, Henry

SCALES, Steel
American Meas. Insts.
Dillon & Co.
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Howe Scale Co.
Lufkin Rule Co.
Streeter-Amet Co.
Toledo Scale Co.

SCALES, Testing
Buffalo Scale Co.
Chatillon & Sons
Dillon & Co.
Eberbach & Sons
Exact Weight Scale
Gump Co.
Howe Scale Co.
Humboldt Mfg. Co.
Jacobs Bros. Co.
Newark Scale Works
Seedburo Equipment
Taller & Cooper
Toledo Scale Co.

SCALES, Textile
Becker Div., Christian
Buffalo Scale Co.
Chatillon & Sons
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Howe Scale Co.
International Bus. Mach.
Seederer-Kohlbusch, Inc.
Streeter-Amet Co.
Suter, Alfred
Toledo Scale Co.
Triner Sales Co.

SCALES, Track
Baldwin Locomotive
Buffalo Scale Co.
Emery Co., A. H.
Fairbanks, Morse & Co.
Howe Scale Co.
Streeter-Amet Co.
Toledo Scale Co.
Yale & Towne Mfg.

SCALES, Truck
Black & Decker
Buffalo Scale Co.
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Howe Scale Co.
Seedburo Equipment
Streeter-Amet Co.
Toledo Scale Co.
Yale & Towne Mfg.

SCALES, Water Meter
Alteneder & Sons
Exace Weight Scale
Fairbanks, Morse & Co.
Jacobs Bros. Co.
Toledo Scale Co.
Yale & Towne Mfg.

SCALES, Yardage
Amthor Testing Inst.
Brown & Sharpe
Buffalo Scale Co.
Exact Weight Scale
Fairbanks, Morse & Co.
Howe Scale Co.
International Bus. Mach.
Kron Co.
Toledo Scale Co.

SCREENS, Solar Projecting
Fecker, Inc.

SCREENS, X-Ray Fluoroscopic
Canadian Radium
Eastman Kodak Co.
General Electric X-Ray
General Luminescent
Goetze-Niemer Co.
Kelley-Koett Mfg. Co.
North American Philips
Patterson Screen Div.
Picker X-Ray
Stoelting Co., C. H.
Westinghouse X-Ray Co.

SCREENS, X-RAY Intensifying (See Screens X-Ray Fluoroscopic)

SEED SIEVE SETS
Ballauf Mfg. Co.
Seedburo Equipment

SEGER CONES (See Cones, Pyrometric)

SEISMOGRAPHS
Alpha Instrument Co.
American Inst. Co.
Brown Geophysical
Century Geophysical
Coleman Inst. & Mfg.
Consolidated Engg.
(Continued)

Engineering Labs., Inc.
Geophysical Instrument
Gilman Scientific
Hathaway Instrument
Henson Co., Fred C.
Helland Research Corp.
Martin-Hubbard Corp.
Mico Instrument Co.
Southwestern Ind. Elec.
Sprengnether Instrument

SELF-OPERATING CONTROLLERS & REGULATORS, AUTOMATIC
American Inst. Co.
Area Regulators, Inc.
Atlas Valve Co.
Automatic Elec. Chicago
Bailey Meter Co.
Bastian-Blessing
Beck Co.
Belfield Div.
Betts & Betts
Bristol Co.
Brooke Engineering
Brown Inst. Div.
Climax Engineering
Cutler-Hammer, Inc.
Dickson Co.
Elec. Indicator Corp.
Fischer & Porter
Fisher-Pierce Co.
Flight Research Eng.
Foxboro Co.
Kiely & Mueller
Leeds & Northrup Co.
Leslie Co.
Leupold & Stevens
Magnetrol Inc.
Manning, Maxwell & Moore
Martin-Hubbard Corp.
Mason-Neilan Regulator
Minneapolis-Honeywell
Mosher Electronics
Partlow Corp.
Perfex Corp.
Robinette Co.
Ruggles-Klingemann
Sarco Co., Inc.
Schade Valve Mfg. Co.
Scientific Inst. Co.
Seely Inst. Co.
Shalleross Controls
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Trerice Co.
Wheelco Instruments

SERVO-MOTORS, Electric Motor
Arma Corporation
Automatic Temp. Control
Barber-Colman
Beck Co.
Brown Inst. Div.
Collins Radio
Doelcam Corp.
Eclipse-Pioneer Div.
Electric Indicator
Electronic Associates
Fairchild Camera
General Elec. Co.
General Regulator Corp.
L. A. B. Corp.
Lear, Inc.
Leeds & Northrup
Martin-Hubbard Corp.
Maxson Corp.
Minneapolis-Honeywell
Reeves Instrument
Robinette Co., W. C.
Schwein Engg.
Servo Corp. of merica
Shalleross Controls
Sperry Gyroscope Co.
Summers Gyroscope
Wilson & Co.

SERVO-MOTORS, Electric Solenoid
Brown Inst. Div.
Clark Cooper Co.
Instrument Dev. Labs.
Martin-Hubbard Corp.
Ruggles-Klingemann
Schwien Eng. Co.
Servo Corp. of Amer.
Shalleross Controls
Summers Gyroscope

SERVO-MOTORS, Hydraulic
Askania Regulator Co.
Bailey Meter Co.
Cash Co.
Dennison Engineering
General Electric
General Regulator Corp.
Hagan Corp.
Martin-Hubbard Corp.
Mason-Neilan Regulator
Maxson Corp.
Republic Flow Meters
Servo Corp. of Amer.
Shalleross Controls

SERVO-MOTORS, Mechanical
Airflo Instrument Co.
Buehler & Co.
Foxboro Co.
Hagan Corp.
Lears, Inc.
Martin-Hubbard Corp.
Servo Corp. of America
Summers Gyroscope

SERVO-MOTORS, Pneumatic
Askania Regulator Co.
Bailey Meter Co.
Brown Inst. Div.
Cash Co.
Emery Co., A. H.
Hagan Corp.
Mason-Neilan Regulator
Maxson Corp.
Minneapolis-Honeywell
Moore Products
Republic Flow Meters
Servo Corp. of Amer.

SEXTANTS
Alpha Instrument Co.
Bausch & Lomb Opt.
Bray Optical Co.
Dusenbery Co.
Eclipse-Pioneer Div.
Fairchild Camera
Keuffel & Esser Co.
Kuner Co., Max
Leupold & Stevens
Link Aviation Devices
Negus, T. S. & J. D.
Suverkop Instruments
Unertl Optical Co.
Warren-Knight Co.
White Co., Inc.

SHIP LOGS
Elec. Tachometer Corp.
Kenyon Instrument Co.
Negus, T. S. & J. D.
Pitometer Log Corp

SHUNT METERS (See Meters, Shunt)

SHUNTS
Associated Research
Bradshaw
Burlington Inst Co.
Cole Instrument
Columbia Elec. Mfg.
De Jur-Amsco
Electronic Dev. Lab.
Esterline-Angus Co.
General Elec. Co.
Gray Instrument
Hickok Elec. Inst. Co.
Instrument Resistors, Inc.
International Resistance
Leeds & Northrup
Lewis Engineering
Madison Elec. Prod. Div.
Norton Electrical Inst.
Precision Resistor Co.
Radio City Products Co.
Rawson Electrical Inst.
Reiner Electronics
Roller-Smith Co.
Rubicon Co.
Sangamo Electric
Sensitive Research Inst.
Shalleross Mfg.
Standard Science Sup.
Simpson Electric Co.
Sun Manufacturing
Triplett Electrical Inst.
Westinghouse Elec.
Weston Elec. Inst. Corp.
Winslow Co.

SHUNTS, Standard
Associated Research
Cambridge Instrument Co.
Cole Instrument
De Jur-Amsco
Electronic Dev. Lab.
Esterline-Angus Co.
General Electric Co.
Gray Instrument Co.
Hickok Electrical Inst.
Instrument Resistors Co.
International Resistance
Leeds & Northrup Co.
Lewis Engineering
Roller-Smith Co.
Rubicon Co.
Sensitive Research Inst.
Shalleross Mfg.
Triplett Elec. Inst. Co.
Weston Elec. Inst. Corp.
Winslow Co.

SIEVE SHAKERS
American Inst. Co.
Braun Corp.
Central Scientific
Dietert Co.
Humboldt Mfg. Co.
Newark Wire Cloth
Precision Scientific
William Apparatus

SIEVES, TESTING
American Inst. Co.
Central Scientific Co.
Dietert Co.
Fisher Scientific Co.
Humboldt Mfg. Co.
Newark Wire Cloth
Precision Scientific Co.
Riehle Division
Scientific Inst. Co.
Weber Brothers Metal

SIGHT FEED BUBBLERS
Bailey Meter Co
Fischer & Porter
Meriam Instrument
Moore Products

SIGHT METERS
De Jur-Amsco
General Elec. Co.
G-M Labs.
Triplett Elec. Inst.
Weston Elec. Inst. Corp.

SIGHTS, GUN, Telescopic
Bausch & Lomb Opt.
Bell & Howell Co.
Clark & Sons
Fecker, Inc.
Kollmorgan Optical Co.
Leupold & Stevens
Palos Optical Co.
Perkin-Elmer Corp.
Plummer & Kershaw
Unertl Optical Co.
Zeiss, Inc., Carl

SIGNAL GENERATORS (See Generators, Signal)

SIGNALING DEVICES Automatic
Auth Elec. Spec.
Autocall Co.
Automatic Elec. Chicago
Automatic Elec. Mfg.
Automatic Temp. Controls
Bailey Meter Co.
Beck & Co.
Betts & Betts
Browning Labs.
(Continued)

Bullard Co.
Cannon Electric
Cincinnati Time Rec.
Clark Cooper Co.
Eastern Industries
Elec. Indicator Corp.
Fischer & Porter
Foxboro Co.
General Elec. Co.
Guardian Elec. Mfg. Co.
Haydon Co., A. W.
Holtzer-Cabot Elec. Co.
Industrial Timer Corp.
International Bus. Mach.
Leslie Co.
Leupold & Stevens
Lumenite Co.
Martin-Hubbard Co.
Mine Safety App. Co.
National Time & Signal
Panellit, Inc.
Photoswitch, Inc.
Production Instrument
Rosen Engg.
Spence Engineering Co.
Standard Elec. Time
Thompson Clock Co.
Viking Instruments
Wallace & Tiernan
Warren Telechron
Wheelco Instruments

SIGNALING DEVICES, Traffic
Am. Gas Accumulator
Automatic Elec. Sales
Automatic Temp. Control
Bawden Bros.
Bullard Co.
Eagle Signal Corp.
Eastern Industries
Edison Electrical Controls
General Elec. Co.
National Time & Signal
Photoswitch, Inc.
Sangamo Electric Co.

SILICA, VITREOUS
Crystal Research Labs.
General Electric
Thermal Syndicate, Ltd.

SINE BARS
DoAll Co.
Herkimer Tool
Jansson Gage Co.
Swedish Gage Co.
Thomas Tool
Vinco Corp.

SLIDE RULES (See Drawing Instruments)

SLIDING GAGES (See Gages, Sliding)

SLOW MOTION STUDY EQUIPMENT
Annis Co.
Bolsey Corp.
Boulin Instrument Corp.
Commercial Engg. Labs.
General Radio Co.
Telechron, Inc.

SLUMP CONES (See Cones, Slump)

SMOKE DENSITY, Indicators & Recorders
Ace Instrument Co.
Airdesign, Inc.
Associated Research
Bailey Meter Co.
Bristol Co.
Brooke Engineering
Cole Instrument
Denver Fire Clay Co.
Dickson Co.
Electronic Lab.
Ess Instrument Co.
General Elec. Co.
General Power Plant
General Television Corp.
Leeds & Northrup Co.
Lumenite Elec.
McNeill Engineering
Photoswitch, Inc.
Photovolt Corp.
Preferred Utilities Mfg.
Refinery Supply
Thwing-Albert Inst. Co.
Weston Elec. Inst. Corp.
Worner Electronics

SMOOTHNESS RECORDERS (See Surface Finish Analyzers)

SOLAR PROJECTING SCREENS (See Screen, Solar Projecting)

SOUND INDICATORS & ANALYZERS (See Indicators, Sound & Analyzers, Sound)

SOUND LEVEL METERS
Amplifier Co.
Assembly Products
Audio Development
Audio-Tone Oscillator
Ballantine Labs.
Burlington Inst. Co.
Clough-Brengle Co.
Cole Instrument
Dale Instruments
Daven Co.
De Jur-Amsco Corp.
Electro-Tech Equipment
Electronic Development
General Elec. Co.
General Radio Co.
Hickok Elec. Inst.
Marion Electrical Inst.
Massa Labs.
Meters, Inc.
Precision Apparatus Corp.
Radio City Products Co.
RCA Div.
Scott, Inc., Hermon
Shalleross Mfg. Co.
Sherron Metallic
Simpson Electric
Sound Apparatus Co.
Triplett Electric Inst.
Viking Instruments
Western Electric
(Continued)

Westinghouse Elec.
Weston Elec. Inst. Corp.

SOUNDING LEADS
Bliss & Co.
G. M. Mfg. Co.
Kahl Sci. Inst. Co.
Kenyon Instrument Co.
Moeller Instrument Co.
Negus, T. S. & J. D.

SOUNDING MACHINES
Bendix Marine Products
G. M. Mfg. Co.
Hand & Sons
Kahl Sci. Inst. Co.
Kenyon Instrument Co.
Moeller Instrument Co.
Negus, T. S. & J. D.

SOUNDING TUBES
Kimble Glass Co.
Leupold & Stevens
Moeller Instrument Co.
Negus, T. S. & J. D.

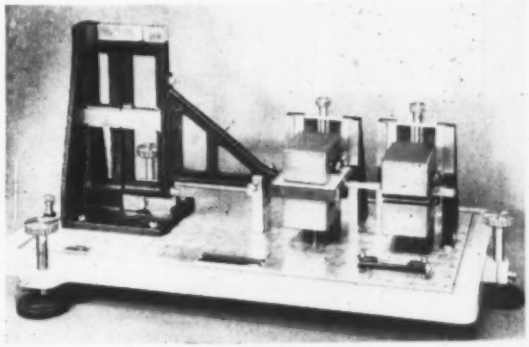
SPECIFIC GRAVITY Indicators & Recorders
American Meter Co.
Bailey Meter Co.
Baird Associates
Builders-Providence
Fischer & Porter
Foxboro Co.
Refinery Supply Co.
G. M. Mfg. Co.
Hagan Corp.
Hays Corp.
Leeds & Northrup
Moeller Inst. Co.
Moore Products
Permutit Co.
Poole Instruments
Precision Scientific
Refinery Supply
Republic Flow Meters
Ruehfel Co.
Schultheis Corp.
Schutte & Koerting
Scientific Inst. Co.
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Trerice Co.
Wallace & Tiernan

SPECTRAL TUBES CONTAINING RARE GASES (See Spectrum Tubes)

SPECTROGRAPHS
Applied Research Labs.
Baird Associates
Bausch & Lomb Optical
Biddle Co.
Farrand Optical
Fecker, Inc.
Gaertner Scientific Corp.
Heinrich Co., Carl
Henson Co., Fred C.
Jarrell-Ash
Spencer Lens Co.
Unertl Optical Co.
Zeiss, Inc., Carl

SEISMOGRAPHS

For Recording Earthquakes and other Ground Motions.



Long Period Horizontal Component
Series H

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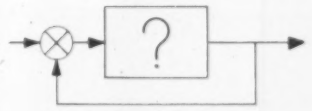

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AUTOMATIC CONTROL SYSTEMS
is through the use of the instrument designed to provide all the essential information

The Type 6
SERVO ANALYZER*
See page 23

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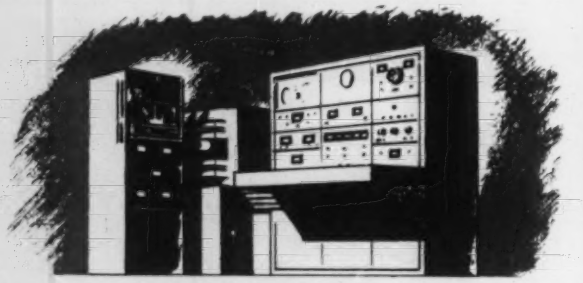

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ENGINEERS AND MANUFACTURERS

SPECTROGRAPHS, Mass
Berkeley Scientific
Furst Electronics
General Electric Co.
Process & Instruments
Phoenix Precision Insts.
Skaneateles Mfg. Co.

SPECTROGRPAHS, Oscillating
General Elec. Co.
Hayes Scientific App.
Unertl Optical Co.

SPECTROGRAPHS, Raman
Jarrell-Ash Co.
Lane-Wells Co.

SPECTROGRAPHS, Vacuum
Baird Associates
Biddle Co.
Central Scientific Co.
Dietert Co.
Farrand Optical
Fecker, J. W.
Jarrell-Ash Co.
Lane-Wells Co.
Skaneateles Mfg. Co.
Thomas Co., Arthur H.
Unertl Optical Co.

SPECTROGRAPHS, X-ray
Biddle Co.
Central Scientific Co.
Gaertner Scientific
General Electrical X-Ray
Hayes Scientific App.
Henson Co., Fred C.
Jarrell-Ash Co.
Kelley-Koett Mfg.
North Amer. Philips
Unertl Optical Co.
Victoreen Instrument Co.
Wyland, G. C.

SPECTROMETERS
American Optical
Applied Research Labs.
Baird Associates
Bausch & Lomb Optical
Consolidated Engg.
Dearborn Scientific
Farrand Optical
Gaertner Scientific
Jarrell-Ash Co.
Martin-Hubbard Corp.
National Tech. Labs.
Perkin-Elmer Corp.
Rudolph & Sons
Unertl Optical Co.
Welch Scientific

SPECTROMETERS, Infra-Red
Baird Associates
Farrand Optical Co.
Gaertner Scientific Corp.
General Elec. Co.
Jarrel-Ash. Co.
National Tech. Labs.
Perkin-Elmer Corp.
Pfaltz & Bauer
Phoenix Prec. Inst.

SPECTROMETERS, Recording, Mass
Berkley Scientific
Consolidated Engg.
Furst Electronics
General Electric Co.
Process & Instruments
Unertl Optical Co.

SPECTROMETERS, X-RAY (See Spectrograph, X-Ray)

SPECTRO-PHOTO-METERS (See Photometers, Spectro)

SPECTROPHOTO-METERS, Ultra-Violet
Applied Physics Corp.
Farrand Optical
General Elec. Co.
Jarrell-Ash Co.
Phoenix Precision Inst.

SPECTROSCOPES
American Optical
Bausch & Lomb Opt.
Central Scientific Co.
Dearborn Scientific
Fecker, Inc.
Fish-Schurman Corp.
Gaertner Scientific Corp.
General Elect. X-Ray
Jarrell-Ash Co.
Laboratory Specialties
Leitz, Inc.
Rudolph & Sons
Unertl Optical Co.
Welch Scientific

SPECTROSCOPE, Quartz
Gaertner Scientific Corp.
Unertl Optical Co.

SPECTROSCOPES, Stellar
American Optical Co.
Central Scientific Co.
Eastern Scientific Co.
Fecker, Inc.
Mico Instrument Co.
Perkins-Elmer Corp.
Unertl Optical Co.
Zeiss, Inc., Carl

SPECTRUM TUBES
Central Scientific Co.
Gaerter Scientific Corp.
General Physical Lab.
Jarrell-Ash Co.
Skaneateles Mfg. Co.

SPEED, Indicators
Amthor Testing Inst. Co.
Associated Research
Automatic Elec. Chicago
Bailey Meter Co.
Biddle Co., Jas. G.
Boulin Instrument Corp.
Bristol Co.
Brown Inst. Div.
Brown & Sharpe
(Continued)
Chicago Elec. Tachometer
Cincinnati Time Rec.
Cole Instrument
Commercial Research
Cramer & Co., Inc.
Electric-Speed Ind. Co.
Elec. Tachometer Corp.
Elgin National Watch
Engineering Res. Dev.
Esterline-Angus Co.
Foxboro Co
Gaertner Scientific Corp
General Elec. Co.
General Radio
Hasler-Tel. Co.
Hastings Inst. Co.
Hathaway Inst. Co.
Hickok Elec. Inst. Co.
Jaeger Watch Co.
Jones-Motrola
Leeds & Northrup Co.
Manning, Maxwell & Moore
McDonnell Odometer Co.
Metron Instrument Co.
Moisture Register Co.
Potter Instrument
Precision Therm.
Roller-Smith
Sangamo Electric Co.
Scherr Co., Inc.
Standard Elec. Time
Starrett Co.
Sticht Co.
Triplett Elec. Inst.
U. S. Taximeter
Veeder-Root, Inc.
Westberg Mfg. Co.
Westinghouse Elec.
Weston Elec. Inst. Corp.
Zernickow Co., O.

SPEED, Recorders (See Speed Indicators)

SPEED, Regulators (See Controllers, Automatic, Tachometric)

SPEED SYNCHRONIZING INDICATORS
Cole Instrument
Electric Speed Ind. Co.
Electric Tachometer
General Elec. Co.
Westberg Mfg. Co.

SPEEDOMETERS
Boulin Instrument Corp.
Central Scientific Co.
Commercial Research
Corbin Screw Corp.
Cramer & Co., Inc.
Electric Auto-lite
Elec. Tachometer Corp.
Electronic Associates
Engineerig Res. & Dev.
General Elec. Co.
Jones-Motrola
Stewart-Warner Corp.
Westinghouse Elec.

SPHYGMOMANOMETERS
Cambridge Inst. Co.
G. M. Mfg. Co.
Hellige, Inc.
Kahl Sci. Inst. Co.
Precision Thermometer
Stoelting Co., C. H.
Taylor Inst. Cos.

SQUARES, Combination & Machinists'
Brown & Sharpe
DoAll Co.
Jansson Gage Co.
Lufkin Rule Co.
Mico Instrument Co.
Millers Falls
Starrett Co.
Thomas Tool
Union Tool Co.
Vinco Corp.
Warren-Knight Co.

STANDARD CELLS (See Cells, Standard)

STANDARD, Acoustic
Massa Laboratories

STANDARD, Capacitance
Aerovox Corp.
Cambridge Inst. Co.
General Radio Co.
Industrial Instruments
Leeds & Northrup Co.
Rubicon Co.
Solar Mfg. Corp.
United Condenser

STANDARDS, Color
Fish-Schumann Co.
Hellige, Inc.
Munsell Color Co.
Tagliabue Corp., C. J.
Taylor & Co., W. A.

STANDARDS, E.m.f.
Cambridge Inst. Co.
Leeds & Northrup Co.
Gray Instrument
Rubicon Co.

STANDARDS, Frequency
American Inst. Co.
American Time Prods.
Browning Laboratories
Crystal Research Labs.
Espey Mfg.
Ferris Inst. Cor.
General Elec. Co.
General Radio Co.
Hewlett-Packard Co.
MacLeod & Hanopol
Millen Mfg. Co.
Potter Instrument
RCA Div.
Reverbank Laboratories
Sherron Metallic
Telechron, Inc.
Times Facsimile Corp.
Western Electric

STANDARDS, Inductance
Cambridge Inst. Co.
General Radio Co.
Leeds & Northrup Co.
Rubicon Co.

STANDARDS, Length
Acme Industrial
Gaertner Scientific Corp.
Gurley, W. & L. E.
Sheffield Corp.
Size Control Co.
Swedish Gage Co.
Van Keuren Co.

STANDARDS, Mass
Gurley, W. & L. E.
Seedrer-Kohlbusch, Inc.

STANDARDS, Potential
Leeds & Northrup Co.
Rubicon Co.
Sensitive Research Inst.

STANDARDS, Pressure
Green, Henry J.
Precision Therm.

STANDARDS, Resistance
Associated Research
Beck Bros.
Cambridge Inst. Co.
Cole Instrument
Cutler-Hammer, Inc.
Federal Instrument
General Radio Co.
Gray Instrument
Hardwick, Hindle, Inc.
Industrial Insts. Inc.
Instruments Resistors Co.
International Resistance
Leeds & Northrup Co.
Resistance Products Co.
Rubicon Co.
Sensitive Research Inst.
Shallcross Mfg. Co.
Sticht & Co.
Victoreen Instrument Co.
Ward Leonard Elec. Co.
General Radio Co.
Massa Labs.
RCA Div.
Shallcross Mfg. Co.
Western Electric

STANDARDS, Sound Level
Audio Tone Oscillator
Massa Laboratories

STANDARDS Temperature
Ever Ready Thermometer
Green, Henry J.
Leeds & Northrup Co.
Moeller Instrument Co.
Precision Therm.
Revere Co.
Tagliabue Corp., C. J.

STANDARDS, Time
American Inst Co.
American Time Prods.
Gaertner Scientific Corp.
General Radio Co.
Potter Instrument
Standard Elec. Time Co.
Stoelting Co., C. H.
Varo Mfg. Co.
Warren Telecron Co.

STANDARDS, Volume
Gurley, W. & L. E.
Kontes Glass Co.

STATION CONTROL EQUIPMENT
American Meter Co.
Arca Regulators Inc.
Control Corp.
Elec. Indicator Corp.
General Elec. Co.
RCA Manufacturing
Sherron Metalic

STEAM METERS (See Flow Meters, Steam)

STEEL TAPES (See Tapes Steel)

STELLAR SPECTRO-SCOPES (See Spectroscopes, Stellar)

STEREOSCOPES
Abrams Instrument
Fairchild Camera

STEREOSCOPES, X-RAY
Abrams Instrument
Bausch & Lomb Optical
Fairchild Camera
General Elec. X-Ray
Kelley-Koett Mfg. Co.
North American Philips
Picker X-Ray
Westinghouse X-Ray Co.

STETHOSCOPES, ENGINEERS
Brush Development Co.
Engineers Res. & Dev.
Fairchild Camera
Gilmore, E. R.

STIFFNESS TESTERS, PAPER (See Tester, Stiffness, Paper)

STILLS, AUTOMATIC WATER
Barnstead Still & Steril
Central Scientific Co.
Electric Hotpack Co.
Fish-Schurman Co.
Goetze Niemer
Precision Scientific
Specialty Glass Co.
Stokes Machine Co.
Weber Bros. Metal Works

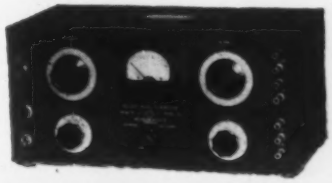
STIRRERS, LABORATORY, Variable Speed
Aloe Co., A. S.
American Inst. Co.
Central Scientific
Eastern Engg. Co.
Eberbach & Son
Fish-Schurman Corp.
Fisher-Scientific
Humboldt Mfg. Co.
Omega Machine
Palo-Myres, Inc.
Precision Scientific
Technical Products

STOP WATCHES (See Watches, Stop)

Laboratory Standards

SQUARE WAVE GENERATOR
MODEL 71

FREQUENCY: 6 to 100,000 cycles.
WAVE SHAPE: Rise time less than 0.2 microseconds.
OUTPUT VOLTAGE: Step attenuator, 75, 50, 25, 15, 10, 5 peak volts fixed. 0-2.5 volts cintinuously variable.
SYNC. OUTPUT: 25 volts peak.
R. F. MODULATOR: 5 volts maximum carrier input.
POWER SUPPLY: 117 volts, 50-60 cycles.
DIMENSIONS: Width 15", height 7", depth 7½".
WEIGHT: 20 lbs.



MEASUREMENTS CORPORATION BOONTON NEW JERSEY

STRAIGHT EDGES
Acme Industrial
American Mega. Inst.
Brown & Sharpe
Burning Co., Inc.
Dietzen Co.
Keuffel & Esser Co.
Negus, T. S. & J. D.
Scherr Co., George
Spidel & Co.
Swedish Gage Co.
Warren-Knight Co.
Weber Co., F.
White Co., David

STRAIGHTENING VANES
Bailey Meter Co.
Builders Providence
Penn Ind. Inst. Corp.
Robinson Orifice Fitting
Simplex Valve & Meter
Taylor Instrument Cos.

STRAIN GAGES (See Gages, Strain)

STRAIN TESTERS, GLASS (See Testers, Strain (Glass)

STRAIN-TIME RECORDERS
Bailey Meter Co.
Baldwin Locomotive
Brush Development
Cambridge Inst. Co.
Consolidated Engineering
Foxboro Co.
Hathaway Instrument
Keuffel & Esser Co.

STEAM GAGING INSTRUMENTS
Foxboro Co.
Gurley, W. & L. E.
Hathaway Instrument
Keuffel & Esser Co.
Leupold & Stevens
Martin-Hubbard Corp.

STRESS INDICATORS
Ames Co., B. C.
Bailey Meter Co.
Baldwin Locomotive
Cambridge Inst. Co.
Consolidated Engg.
Dillon & Co.
Emery Co., A. H.
Federal Products Corp.
General Electric Co.
Hathaway Instrument
Magnaflux Corp.
Metron Instrument
Riehle Div.
Statham Labs.

STRESS-STRAIN, Indicators
Ames Co., B. C.
Anderson, Arthur R.
Bailey Meter Co.
Baldwin Locomotive
Brush Development
Chatillon & Sons
Consolidated Engg.
Electronic Products
Emery Co., A. H.
Hathaway Instrument
Magnaflux Corp.
Metron Instruments
Nosker Eng. Prod.
Sheffield Corp.
Statham Labs.
Swedish Gage Co.
Taller & Cooper
Trimount Inst. Co.

STRESS-STRAIN, Recorders
Bailey Meter Co.
Baldwin Locomotive
Brush Development
Cambridge Inst. Co.
Century Geophysical
Consolidated Engg.
Electronic Products
Emery Co., A. H.
Flader, Inc., Fredric
Hathaway Instrument
Metron Instruments
Nosker Eng. Prod.
Olsen Testing Machine
Riechle Div.
Sheffield Corp.
Statham Labs.
Taller & Cooper
Trimount Inst. Co.

STOBOSCOPES
Associated Research
Biddle Co., Jos. G.
Boulin Inst. Corp.
Commercial Research
Communication Meas. Lab.
Conn, Ltd., C. G.
Electric Eye Equip.
Electronic Engineers
General Radio Co.
Ideal Laboratory Tool
(Continued)

Sylvania Elec. Prod.
Welch Mfg. Co.
Westinghouse Elec.
Zeiss, Inc., Carl

SULPHUR BOMBS (See Bombs, Sulphur)

SULPHUR DIOXIDE, Indicators (See Gas Analyzers, Sulphur Dioxide) Recorders (See Gas Analyzers, Sulphur Dioxide)

SUN COMPASS
Abrams Instrument
Dusenbury Co.
Geophysical Inst. Co.

SUNSHINE, Indicators & Recorders
Cambridge Inst. Co.
Esterline-Angus Co.
Friez Instrument
General Elect. Co.
G. M. Mfg. Co., Inc.
Instruments Corp.
Leeds & Northrup Co.
Taylor Inst. Co.
White Co., Inc.

SUPERVISORY CONTROL EQUIPMENT
Autocall Co.
Automatic Elec. Chicago
Bristol Co.
Builders Providence
Control Corp.
Cramer & Co., Inc.
General Elec. Co.
Guardian Elec. Mfg. Co.
Leeds & Northrup Co.
Tagliabue Corp., C. J.
Westinghouse Elec.

SURFACE FINISH COMPARATORS (See Comparators, Surface Finish)

SURFACE FINISH SPECIMENS
Acme Industrial
Baird Associates
Blake Co., Edward
Brush Development
General Elec. Co.
Link Eng. & Mfg.
Pipe Machinery
Surface Checking Gage.

SURFACE FINISH STANDARDS
Brush Development
Pipe Machinery Co.
Surface Checking Gage

SURFACE FINISH TESTERS
Baird Associates
Blake Co., Edward
Brush Development Co.
Buehler, Adolph I.
Comtor Co.
Federal Products Corp.
General Elec. Co.
Link Eng. & Mfg.
Physicists Research
Sheffield Corp.
Surface Checking Gage
Swedish Gage
Taber Inst. Corp.
Wilder, R. S.
Williams Apparatus
Zuhr Co., Henry J.

SURFACE GAGES (See Gages, Surface

SURFACE PLATES GLASS
Bausch & Lomb Optical
Binswanger & Co.
Clark & Sons
DoAll Co.
Feeker, J. W.
Fish-Schurman Co.
Geophysical Inst. Co.
Mogey & Sons
Palos Optical Co.
Zeiss, Inc., Carl

SURFACE PLATES STONE
Herman Stone Co.

SURGE CREST AMMETERS (Ammeters, Surge-Crest)

SURGE, Indicators & Recordings
Cook Electric
Elec. Indicator Corp.
Esterline-Angus Co.
General Electric Co.
Hathaway Instrument
Landis & Gyr.
Sheffield Corp.
Taylor Inst. Cos.

SURVEYING INSTRUMENTS
Abrams Instrument
Alpha Instrument Co.
Beckman Co., L.
Berger & Sons
(Continued)

Bliss & Co.
Bray Optical Co.
Bruning Co., Inc.
Dietzgen Co.
Ferner Co.
Geier & Bluhm
Goldak Co.
Gurley, W. & L. E.
Hastings Inst. Co.
Kenyon Instrument Co.
Keuffel & Esser Co.
Kolesch & Company
Leupold & Stevens
Lufkin Rule Co.
Pittsburgh Ins. & Mach.
Post Co., Frederic
Speedometer Electric Co.
Speidel & Co.
Starrett Co.
Suverkrop Instruments
Ulmer Co., J. C.
United States Blue Print
Warren Knight Co.
Weber Co.
White Co., Inc.
Zeiss, Inc., Carl

SURVEYING INSTRUMENTS, Aneroid
Am. Paulin System
Dietzen Co.
Heinrich Co., Carl
Wallace & Tiernan
Warren-Knight Co.
White Co.

SURVEYING INSTRUMENTS, Underground, for wells or bore holes
Eastman Oil Well
Engineering Labs., Inc.
Geophysical Inst. Co.
Halliburton Oil Well
Heiland Research
Sperry-Sun Well Survey
Warren-Knight Co.
White Co.

SURVEYOR'S CHAINS (See Surveyor's Instruments)

SURVEYORS FOOT METERS
Speedometer Electric Co.

SWITCHES, Air-operated
Automatic Temp. Control
Clark Cooper Co.
Cole Instrument
Cook Electric
Cutler-Hammer, Inc.
General Elec. Co.
Johnson Service Co.
Meletron Corp.
Mu-Switch Corp.
Rotron Div.
Shallcross Mfg. Co.
Tagliabue Corp., C. J.
Westinghouse Elec.

SWITCHES, Automatic Transfer
Acro Switch Co.
Allen-Bradley Co.
Allied Control Co.
Anderson, A. & J. M.
Arrow-Hart & Hegeman
Autocall Co.
Automatic Control Co.
Automatic Electric Chicago
Automatic Switch Co.
Automatic Temp. Control
Barber-Colman
Cook Electric
Cramer & Co., Inc.
Cutler-Hammer, Inc.
Federal Telephone Co.
General Elec. Co.
Hart Mfg. Co.
Haydon Co., A. W.
H-B Instrument
Lumenite Electronic
Ward Leonard Elec. Co.
Westinghouse Elec.

SWITCHES, Instrument
Acro Switch
Allen-Bradley Co.
Allis-Chalmers
Arrow-Hart & Hegeman
Autocall Co.
Automatic Electric Chicago
Automatic Temp. Control
Barber-Colman
Betts & Betts
Carter Parts Div.
Centralab Div.
Cole Instrument
Cook Electric
Cutler-Hammer, Inc.
Daven Co.
Federal Anti-Capacity
General Cement Mfg.
General Elec. Co.
General Radio Co.
Hart Mfg. Co.
Industrial Insts., Inc.
J-B-L Inst. Co.
(Continued)

J-B-T Instruments
Kellogg Switchboard
Lewis Engg.
Mallory & Co.
McDonnell & Miller
Mercoid Corp.
Meter Devices Co.
Micro Switch Div.
Mossman, Inc.
Ohmite Mfg. Co.
Roller-Smith
Rubicon Co.
Sensitive Research Co.
Shalcross Mfg.
Teleoptic Co.
Thwing-Albert Instrument
Trimount Inst. Co.
Triplett Elec. Inst. Co.
United States Inst. Corp.
Westinghouse Elec.
Weston Elec. Inst. Corp.
Wheelco Instrument
Winston Co.

SWITCHES, Magnetic
Allen Bradley Co.
Allis-Chalmers
Arrow-Hart & Hegeman
Autocall Co.
Automatic Switch Co.
Automatic Temp. Control
Clark Cooper Co.
Cook Electric
Cutler-Hammer, Inc.
General Cement Mfg.
General Elec. Co.
Magneswitch Inc.
Soreng Mfg. Co.
Ward Leonard Elec. Co.

SWITCHES, Mercury
Arrow-Hart & Hegeman
Climax Engineering
Continental Elec. Co.
Cutler Hammer, Inc.
Electro-Tech Equipment
Fredericks, George
General Cement Mfg.
General Elec. Co.
H-B Instrument
Magnetrol Inc.
McAlear Mfg. Div.
Mercoid Corp.
Minneapolis-Honeywell
Rhodes, Inc.

SWITCHES, Pyrometer
Acro Switch Co.
Arrow-Hart & Hegeman
Bristol Co.
Brown Inst. Div.
Cole Instrument
Daven Co.
Engelhard, Chas.
Foxboro Co.
General Cement Mfg.
General Elec. Co.
J-B-L Instrument
Leeds & Northrup Co.
Lewis Engg Co.
Revere Corp.
Rowe Engineering
Tagliabue Corp., C. J.
Thwing-Albert Inst. Co.
Triplett Elec. Inst.
United States Inst. Corp.
Westinghouse Elec.
Weston Elec. Inst. Corp.
Wheelco Instruments
Winslow Co.

SWITCHES, Relay
Acro Switch Co.
Allen-Bradley Co.
Arrow-Hart & Hegeman
Autocall Co.
Automatic Elec. Chicago
Automatic Switch Co.
Automatic Temp. Control
Betts & Betts
Clark & Co.
Cook Electric Co.
Cutler-Hammer, Inc.
Friez Instruments
General Cement Mfg.
General Controls Co.
General Elec. Co.
Guardian Elec. Mfg. Co.
Hart Mfg Co.
H-B Instrument
Kellogg Switchboard
Mallory & Co.
Meter Devices Co.
Micro Switch Div.
Perfex Corp.
Photoswitch, Inc.
Roller-Smith
Skaneateles Mfg. Co.
Struthers-Dunn
Ward Leonard Elec. Co.
Warrick Co.
Westinghouse Elec.
General Cement Mfg.
(Continued)

General Control Co.
General Controls

SWITCHES, Rotary
Allen-Bradley Co.
Applied Science Corp.
Arrow-Hart & Hegeman
Autocall Co.
Automatic Elec. Chicago
Barber-Coleman
Bird Electronic
Carter Parts Div.
Centralab Div.
Clarostat Mfg. C.
Cole Instrument
Cutler-Hammer, Inc.
Daven Co.
Eastern Specialty
Federal Telephone
Foxboro Company
General Cement Mfg.
General Control Co.
General Elec Co.
General Radio Co.
Guardian Elec. Mfg. Co.
H-B Instrument
Hetherington & Son
J-B-L- Instrument
J-B-T- Instruments
Leeds & Northrup Co.
Lewis Engg. Co.
Mallory & Co.
Meter Devices Co.
Micro Switch Div.
Ohmite Mfg. Co.
Roller-Smith
Rubicon Co.
Sensitive Research Inst.
Shallcross Mfg. Co.
Tagliabue Corp., C. J.
Thwing-Albert Inst. Co.
Triplett Electrical Inst.
United States Inst. Corp.
Utah Radio Prods.
Westinghouse Elec.
Weston Elec. Inst. Corp.

SWITCHES, Selector
Acro Switch Co.
Allen-Bradley Co.
Allis-Chalmers
Arrow-Hart & Hegeman
Automatic Elec. Chicago
Betts & Betts
Bird Electronic
Carter Radio Div.
Centralab Div.
Cole Instrument
Cook Electric
Cutler-Hammer, Inc.
Daven Co.
Federal Telephone
General Cement Mfg.
General Elec. Co.
Guardian Electric
H-B Instrument Co.
J-B-L- Instrument
Leeds & Northrup Co.
Lewis Engineering
Mallory & Co.
Meter Devices Co.
Mossman, Inc.
Ohmite Mfg. Co.
Revere Co.
Shallcross Mfg. Co.
Soreng Mfg. Co.
Thwing-Albert Inst. Co.
United States Inst. Corp.
Ward Leonard
Westinghouse Elec.
Wheelco Instrument

SWITCHES, Snap
Acro Switch Co.
Arrow-Hart & Hegeman
Automatic Temp. Control
Betts & Betts
Clark Cooper Co.
Cutler-Hammer, Inc.
General Cement Mfg.
General Control Co.
General Controls
General Elec. Co.
Guardian Electric
Hetherington & Son
Mallory & Co.
McAlear Mfg. Div.
Micro Switch Div.
Minneapolis-Honeywell
Mu-Switch Corp.
Perfex Corp.
Unimax Switch Corp.
Ward Leonard Elec. Co.

SWITCHES, Snap Action
Acro Switch Co.
Allen-Bradley Co.
Arrow-Hart & Hegeman
Automatic Elec. Chicago
Barber-Colman
Betts & Betts
Clark Cooper Inc.
Cutler-Hammer, Inc.

General Elec. Co.
Grayhill
Guardian Electric
Hetherington & Son
J-B-L Instrument
Leeds & Northrup Co.
Magnaswitch Inc.
Micro Switch Div.
Mu-Switch Corp.
Soreng Mfg. Co.
Ulanet Co., Geo.
Westinghouse Elec.

SWITCHES, Thermostatic
Acro Switch Co.
Airite Prod. Co.
Advance Electric Co.
Allen-Bradley Co.
Barber-Colman
Betts & Betts
Bridgeport Thermo Co.
Burling Instrument Co.
Clark Cooper Co.
Control Products, Inc.
Cook Electric Co.
Dickson Co.
Edison Electric Controls
Fenwal, Inc.
Friez Instruments
General Cement Mfg.
General Controls
General Elec. Co.
Gleason-Avery, Inc.
Guardian Electric
Hart Mfg. Co.
Mercoid Corp.
Micro Switch Div.
Minneapolis-Honeywell
Mu-Switch Corp.
Perfex Corp.
Shallcross Mfg. Co.
Swith Control & Insts.
Spencer-Thermostat Co.
Struthers-Dunn
Tagliabue Corp., C. J.
Thwing-Albert Inst.
Ulanet Co., George
Unimax Switch Corp.
United Electronic Controls
Viking Instruments
Ward Leonard Electric Co.

SWITCHES, Time
Acro Switch Co.
Allen-Bradley Co.
American Time Corp.
Anderson, A. & J. M.
Autocall Co.
Automatic Elec. Mfg.
Automatic Temp. Control
Barber-Colman
Betts & Betts
Cincinnati Time Rec.
Cramer Co., Inc.
Cutler-Hammer, Inc.
Dimo-Gray Co.
Eagle Signal Corp.
Edison Instrument Div.
Electro-Tech. Equip.
Electyme Motor Prods.
General Cement Mfg.
General Control Co.
General Controls
General Elec. Co.
Guardian Elec. Mfg. Co.
Haydon Co., A. W.
Haydon Mfg. Co.
Industrial Timer
International Register Co.
Landis & Gyr, Inc.
Leich Elec. Co.
Lektra Labs., Inc.
Lumenite Electronic
Lux Clock Mfg. Co.
Mallory & Co.
Mercoid Corp.
Minneapolis-Honeywell
Montgomery Mfg. Co.
Paragon Electric Co.
Perfex Corp.
Photoswitch, Inc.
Photovolt Corp.
Precision Products, Inc.
Richardson-Allen
Rhodes, Inc., M. H.
Sampsel Time Control
Sangamo Electric Co.
States Co.
Stoelting Co., C. H.
Stromberg Time Corp.
Telechron, Inc.
Thomas Clock Co., Seth
Thompson Clock Co.
Tork Clock
Ulanet Co., Geo.
Walker-Jimieson, Inc.
Walser Automatic Timer
Ward Leonard Elec. Co.
Westinghouse Elec.
Yellow Springs Inst.

The Visutac, a visual stroboscopic hand tachometer is widely used in every industry for measuring rotary and vibratory speeds from a distance and without contact. Made in two basic ranges, 500 to 8000 and 1000 to 16,000 R.P.M.-V.P.M.

BOULIN INSTRUMENT CORPORATION
PORTABLE AND STATIONARY CENTRIFUGAL TACHOMETERS
PORTABLE CHRONOMETRIC AND STROBOSCOPIC TACHOMETERS
65 MADISON AVENUE, NEW YORK 16, N. Y.

TACHOMETERS

TYPE "U"
UNIVERSAL CENTRIFUGAL TYPE
5 Ranges in 1 Instrument
Cat. No. 303 30-12,000 RPM
Cat. No. 314 45-18,000 RPM
Cat. No. 322 60-24,000 RPM
Cat. No. 346 120-48,000 RPM
Bulletin 750-N

MODEL "J"
TRIPLE RANGE CENTRIFUGAL
Cat. No. 312 300-12,000 RPM
Cat. No. 1412 100-12,000 RPM
SINGLE RANGES
100-1200 RPM, 200-2400 RPM
300-3600 RPM, 400-4800 RPM
Bulletins 760-N, 790-N

"JAQUET"
SPEED INDICATORS (CHRONOMETRIC)
Guaranteed Accuracy within ½ of 1%
Cat. No. 2301 0-10,000 RPM
Cat. No. 2302 0- 1,000 RPM
Suitable double rated speed. 3 models, various accessories.
Bulletin 735-N

STATIONARY TYPE
MODEL "J"
Sizes, 3", 4", 5½", 8", 10", and 20" dial diameter, flexible shaft driven.
Many standard ranges reading RPM, FPM, YPM, etc.
Bulletins 795-N, 796-N 797-N

HERMAN H. STICHT CO., INC.
27 PARK PLACE NEW YORK, N.Y.

Pierce Watch Co.
Potter Instrument
Scherr Co., Inc.
Standard Elec. Time
Sticht Co.
Zernickow Co., O.

TACHOMETERS, Cross-pendulum
Amthor Testing Inst.
Associated Research
Biddle Co., Jas. G.
Manning, Maxwell & Moore
Sticht Co.
Zernickow Co., O.

TACHOMETERS, Electric
Bailey Meter Co.
Bristol Co.
Brown Inst. Div.
Clarke Inst. Corp.
Cole Instrument
Crown Ind. Prods.
Eclipse-Pioneer Div.
Electric Speed Ind. Co.
Elec. Tachometer Corp.
Electro Mechano Co.
Esterline-Angus Co.
Foxboro Co.
General Elec. Co.
Hastings Inst. Co.
Hathaway Inst. Co.
Hays Corp.
Hickok Elec. Inst. Co.
Ideal Industries, Inc.
Instrument Lab. Inc.
Jaeger Watch Co.
J-B-T Instruments
Jones Motorola Sales
Kollsman Instrument
Martin Decker Corp.
Metron Instruments
Moisture Register Co.
Nat'l. Instrument Co.
Photocon Research
Pitometer Log Corp.
Potter Co.
Rowe Engineering
Scherr Co. Inc.
Standard Elec. Time
Sticht Co.
Sun Electric Corp.
Westberg Mfg. Co.
Westinghouse Elec.
Weston Elec. Inst. Corp.
Winslow Co.
Yellow Springs Inst. Co.

TACHOMETERS, Electromagnetic
Eclipse-Pioneer Div.
Electric Auto-Lite
Electric Tachometers
Electro Mechano Co.
General Electric Co.
Ideal Industries
Jaeger Watch Co.
Kollsman Inst. Co.
Nat'l. Instrument Co.
Standard Elec. Time Co.
Sun Electric
Stewart-Warner Corp.
Triplett Elec. Inst.
Waltham Watch
Westberg Mfg. Co.
Westinghouse Elec.

TACHOMETERS, Fly-ball
Barbour Stockell Co.
Biddle Co., Jas. G.
Boulin Instrument Corp.
Elec. Tachometer Corp.
Jones Motrola Corp.
Manning, Maxwell & Moore
Sticht Co.
Viking Instrument Co.

TACHOMETERS, Portable
Amthor Testing Inst. Co.
Associated Research
Barbour Stockwell Co.
Biddle Co., Jas. G.
Boulin Instrument Corp.
Corbin Screw Corp.
Electro Mechano Co.
Elec. Tachometer Corp.
Foxboro Co.
General Elec. Co.
Hasler-Tel Co.
Ideal Industries
Jones Motrola Corp.
Manning, Maxwell & Moore
Rieker Instrument Co.
Scherr Co., Inc.
Sticht Co.
Sun Electric Corp.
Viking Instrument Co.
Westberg Mfg. Co.
Winslow Co.
Zernikow Co.

TACHOMETERS, Speed Limit Control
Askania Regulator Co.
Barbour Stockwell Co.
Bristol Co.
Flight Research Eng.
General Elec. Co.
Jones Motrola Corp.
Metron Instrument
Sticht Co.
Standard Elec. Time
U. S. Taximeter
Westberg Mfg. Co.
Zernikow Co.

TACHOMETERS, Stroboscopic
Associated Research
Boulin Instrument Corp.
Clarke Inst. Corp.
General Radio Co.
Ideal Laboratory Tool
L. A. B. Corp.
Stewart-Warner Corp.

TACHOMETERS, Tilting-ring
Amthor Testing Inst. Co.
Westberg Mfg. Co.
Zernikow Co.

TACHOMETERS, Vibrating Reed
Biddle Co., Jas. G.
J-B-T Instruments

SYNCHRONIZATION FORKS, Electrical (See Forks, Synchronization)

SYNCHRONOUS MOTORS (See Motors, Synchroneous)

SYNCHROSCOPES
Control Corp.
Eclipse Aviation
Electric Controller
General Elec. Co.
Hickok Elec. Inst. Co.
Kollsman Inst. Co.
Millen Mfg. Co.
Roller-Smith Co.
Triplett Elec. Co.
Westinghouse Elec.
Weston Elec. Inst. Corp.

TACHOGRAPHS
Amthor Testing Inst.
Biddle Co., Jas. G.
Cole Instrument
Cramer & Co., Inc.
Metron Instrument
Sticht Co.
Zeiss, Inc., Carl
Zernickow Co., O.

TACHOMETER TESTERS (See Testers, Tachometer)

TACHOMETERS, Centrifugal
Amthor Testing Inst. Co.
Associated Research
Barbour Stockwell Co.
Biddle Co., Jas. G.
Boulin Instrument Corp.
Corbin Screw Corp.
Durant Mfg. Co.
Eclipse-Pioneer Div.
Elec. Tachometer Corp.
Foxboro Co.
General Elec. Co.
Hays Corp.
Jones Motrola Sales
Kollsman Instrument
Manning, Maxwell & Moore
Pioneer Instrument Co.
Scherr Co., Inc.
Seedburo Equipment
Stewart-Warner Corp.
Sticht Co.
Veeder-Root, Inc.
Viking Instrument Co.
Zernickow Co., O.

TACHOMETERS, Chronometric
Amthor Testing Inst.
Associated Research
Biddle Co., Jas. G.
Boulin Inst. Corp.
Cramer & Co., Inc.
Elec. Tachometer Corp.
Elgin Nat'l. Watch Co.
Hasler-Tel Co.
Jaeger Watch Co.
Milwaukee Lock & Mfg.

(Continued)

TACHOSCOPES
Amthor Testing Inst. Co.
Biddle Co., Jas. G.
Scherr Co., Inc.
Sticht Co.
Zernickow Co., O.

TAFFRAIL LOGS; SHIP
Bliss & Co.
Hand & Sons
Westberg Mfg. Co.

TANGENT METERS (See Meters, Tangent)

TAPES, Oil Gauger's
Dietzgen Co.
Keuffel & Esser Co.
Lufkin Rule
Starrett Co.
White Co., David

TAPES, Steel
Bruning Co., Inc.
Dietzgen Co.
Kueffel & Esser Co.
Lufkin Rule Co.
Soltmann, Inc.
Speidel & Co.
Starrett Co.
United States Blue Print
Warren-Knight Co.
Weber Co.
White Co., David

TAPES, Surveyor's (See Surveying Instruments)

TAPES, Woven
Lufkin Rule Co.
White Co., David

TAXI METERS
U. S. Taximeter

TELEMETERING SYSTEMS (See Remote Metering)

TELEMETERS (Surveying & Military—Optical)
Applied Science Corp.
Kollmorgen Optical Co.
Keuffel & Esser Co.
Pierce Watch Co.

TELESCOPES, Alignment
Acme Industrial
Bray Optical Co.
Dome Precision
Fecker, Inc.
Gaertner Scientific
General Engg. & Model
Howland Optical Co.
Keuffel & Esser Co.
Kollmorgen Optical Co.
Optical Ser. & Dev.
Palos Optical Co.
Perkin-Elmer Corp.
Plummer & Kershaw
Scherr Co., Inc.
Tinsley Laboratories
Unertl Optical Co.
White Co., Inc.

TELESCOPES, Astronimical
Bausch & Lomb Opt.
Buchele, W.
Clark & Sons
Davidson Mfg. Co.
Dome Precision
Eastern Science Co.
Fecker, Inc.
Gaertner Scientific Corp.
Henson Co., Fred C.
Mico Instrument Co.
Palos Optical Co.
Perkin-Elmer Corp.
Plummer & Kershaw
Tinsley Labs.
Unertl Optical Co.
White Co.
Zeiss, Inc., Carl

TELESCOPES, Azimuth
American Optical
Clark & Sons
Fecker, Inc.
Gaertner Scientific Corp.
Kollmorgen Optical Co.
Palos Optical Co.
Perkin-Elmer Corp.
Plummer & Kershaw
Tinsley Labs.
Unertl Optical Co.
Warren-Knight Co.
Warner & Swasey Co.
White Co.
Zeiss, Inc., Carl

TELESCOPES, Bore & Internal Surface, Inspection
American Cystoscope
American Optical
Ames Co., B. C.
Fecker, J. W.
Gaertner Scientific
Gauthier, Donat A.
Kollmorgen Optical Co.
Leitz, Inc.
Lenox Inst. Co.
Magnaflux Corp.
Perkin-Elmer Corp.
Plummer & Kershaw
Scherr Co., Inc.
Schneider-Cogswell
Swedish Gage Co.
Unertl Optical Co.
Zeiss, Inc., Carl

TELESCOPES, Laboratory
American Optical
Bausch & Lomb
Central Scientific
Eberbach & Son
Fecker, Inc.
Gaertner Scientific Corp.
Henson Co., Fred C.
Optical Ser. & Dev.
Palos Optical Co.
Plummer & Kershaw
Ruska & Co.
Tinsley Laboratories
Unertl Optical Co.

TELESCOPES, Reflecting
Buchele, W.
Clark Sons
Fecker, Inc.
Fish-Schurman Co.
Gaertner Scientific
Henson Co., Fred
Howland Optical
Palos Optical Co.
Perkin-Elmer Corp.
Plummer & Kersh
Tinsley Labs.
Unertl Optical Co.
Warner & Swasey
Zeiss, Inc., Carl

TELESCOPES, Reflecting
Buchele, W.
Bausch & Lomb O
Clark & Sons
Davidson Mfg. Co.
Fish-Schurman Co.
Fecker, Inc.
Gaertner Scientific
Henson Co., Fred
Howland Optical
Keuffel & Esser
Palos Optical Co.
Perkin-Elmer Corp.
Plummer & Kersha
Tinsley Labs.
Unertl Optical Co.
Warner & Swasey
Wollensak Optical
Zeiss, Inc., Carl

TELESCOPES, Zenith
Clark & Sons
Fecker, Inc.
Gaertner Scientific Corp.
Perkin-Elmer Corp.
Plummer & Kershaw
Tinsley Labs.
Unertl Optical Co.
White Co., David
Zeiss, Inc., Carl

TENSIOMETERS
Baldwin Locomotive
Boulin Instrument Corp.
Central Scientific Co.
Chattillon & Sons
Dillon Co.
Federal Products Corp.
General Electric Co.
Geophysical Inst. Co.
Metron Instrument
Millers Falls
Olsen Testing Machine
Pacific Scientific
Saxl Instrument
Schaevitz Engineering
Statham Labs.
Suter, Alfred
Thwing-Albert
Toledo Scale Co.

TENSION INDICATORS
Baldwin Locomotive
Boulin Instrument
Chatillon & Sons
Cole Instrument
Dillon Co.
Emery Co., A. H.
Federal Products Corp.
General Electric Co.
Geophysical Inst. Co.
Olsen Testing Mach.
Pacific Scientific Co.
Precision Scientific
Saxl Instrument
Seederer-Kohlbusch, Inc.

TENSION INDICATORS Textile
Boulin Instrument Corp.
Chatillon & Sons
Dillon & Co.
Federal Products Corp.
General Elec. Co.
Olsen Testing Mach.
Pacific Scientific Co.
Saxl Instrument
Statham Labs.

TEST BLOCKS
Brown & Sharpe
Clarke Instrument
Detroit Testing Mach.
Eastern Specialty Co.
Fonda Gage Co.
General Elec. Co.
Kent Cliff Labs.
Meter Devices, Inc.
Olsen Testing Mach.
States Co.
Steel City Testing Mach.
Van Keuren Co.

TEST BLOCKS (Textile)
Boulin Instrument Corp.

TEST INDICATOR
Ames Co., B. C.
Brown & Sharpe
Deming Indicator Co.
Federal Products Corp.
Lewis Engineering
Scherr Co., Inc.
Starrett Co.

TEST STANDS, Propeller
Airplane Mfg. & Supply
Falstrom Co.

TEST WEIGHTS (See Weights, Test)

TEST WELLS (See Thermometer Test Wells)

TESTERS, Abrasion
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Amthor Testing Inst. Co.
Atlas Elec. Devices Co.
Baldwin Locomotive
Fidelity Mach. Co.
Gardner Laboratory
General Elec. Co.
K & H Industrial Prod.
Morehouse Machine Co.
Olsen Testing Machine
Riehle Div.
Scott Testers, Inc.
Shawmut Engr. Co.
Suter, Alfred
Taber Instrument Co.
Testing Machines, Inc.
Welch Engineering Co.
Zuhr, Inc., Henry

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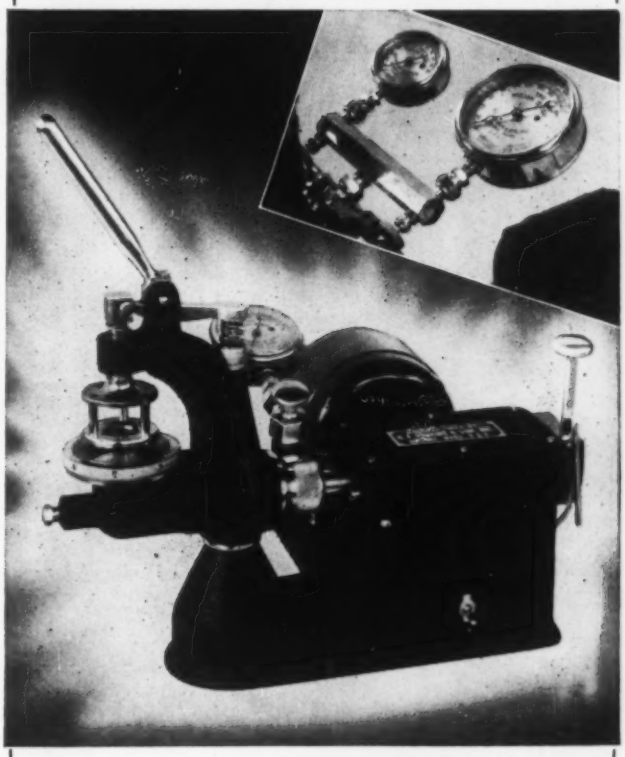

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Model A, motor driven, or Model Jumbo hand-driven for testing materials up to 1000 p.s.i. bursting strength.

Send samples for trial test.

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Holyoke, Mass.

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Humboldt Mfg. Co.
Precision Scientific
Testing Machines, Inc.
Wilams Apparatus

TESTERS, Air Speed Indicator (See Air Speed Indicator Testers)

TESTERS, Altimeter (See Altimeter Testers)

TESTERS, Armature
Associated Research, Inc.
Communication Meas. Lab.
Instrument Labs.
Schauer Machine
Sherron Metallic

TESTERS, Asphalt
American Inst. Co.
Atlas Eectric Devices
Bowen & Co.
Braun Corp.
Central Scientific Co.
Chatillon & Sons
Dillon & Co.
Exact Weight Scale
Fish-Schurman Co.
Fisher Scientific Co.
Humboldt Mfg. Co.
Koehler Instrument
Olsen Testing Mach.
Philadelphia Thermometer
Precision Scientific Co.
Riehle Test. Mach. Div.
Scott Testers, Inc.
Tagliabue Corp., C. J.
Thwing-Albert Inst.

TESTERS, Axle
Olsen Testing Mach.
Riehle Test. Mach. Co.
Sperry Products, Inc.

TESTERS, Battery
Clough-Brengle Co.
Daven Co.
Edelman & Co.
Electro-Mech. Inst.
Electronic Development
Freas Glass Works
General Electric Co.
Hickok Elec. Inst. Co.
Instrument Labs.
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Rascher & Betzold
Rieker Inst. Co.
Sterling Mfg. Co.
Testrite Inst. Co.
Triplett Elec. Inst.
Weston Elec. Inst. Corp.

TESTERS, Bearing
Elgin National Watch
Engineering Res. & Dev.
Physicists Research

TESTERS, Beating
Precision Scientific
Testing Machines, Inc.
Williams Apparatus Co.

TESTERS, Brake
American Inst. Co.
Clough-Brengle Co.
Commercial Research
Cramer & Co., Inc.
Emery Co., A. H.

TESTERS, Chlorine
Everson Mfg. Co.
Heiligе, Inc.
Industrial Inst., Inst.
LaMotte Chemical Prods.
Photovolt Corp.
Precision Scientific
Rascher & Betzold
Taylor & Co., W. A.
Wallace & Tiernan

TESTERS, Coal (See Fuel below)

TESTERS, Coil (Electric)
Associated Research
Boonton Radio Corp.
Clippard Inst. Lab.
Clough-Brengle Co.
Cole Instruments
General Elec. Co.
General Radio
Ideal Industries
Industrial Insts., Inc.
Instrument Labs.
Kellogg Switchboard
Panoramic Radio Co.
Radex Corp.
Rubicon Co.
Schauer Machine
Sherron Metallic
Technology Instrument
Thordarson Elec. Mfg.
United Transformer

TESTERS, Color
Atlas Electric Devices Co.
Fisher Scientific Co.
Gaertner Scientific Corp.
Gardner Laboratory
General Elec. Co.
Heiligе, Inc.
Instrument Dev. Labs.
Photovolt Corp.
Tagliabue Corp., C. J.

TESTERS, Condenser
Aerovox Corp.
Associated Research
Bradshaw Instruments
Clippard Inst. Lab.
Clough-Brengle Co.
Cornell Dubilier
Electronic Development
General Electric Co.
General Radio Co.
Hickok Elec. Instrument
(Continued)

Industrial Insts. Inc.
Instrument Labs.
Jackson Electrical Inst.
Kalbfell Labs., Inc.
Kellogg Switchboard
Potter Co.
Radio City Products
Reiner Electronics
Rubicon Co.
Schauer Machine
Sherron Metallic
Tobe Deutschmann Corp.
Triplett Electrical Inst.
Weston Elec. Inst. Corp.
Williams Apparatus

TESTERS, Deflection, Light Wave
Acme Industrial
Gaertner Scientific Corp.
Sherron Metallic
Van Keuren Co.

TESTERS, Dew Point
Ferner Co.
General Electric
Instrument Dev. Labs.
Refinery Supply Co.
Tagliabue Corp., C. J.

TESTERS, Dielectric, Properties
American Transformer Co.
Associated Research, Inc.
Cole Instrument
Electronic Dev. Lab.
General Elec. Co.
General Radio
Instrument Labs.
Leeds & Northrup Co.
Miller Co., B. F.
Roller-Smith
Sherron Metallic
Tagliabue Corp., C. J.
Westinghouse Elec.
Winslow Co.

TESTERS, Electroplating (See Electroplating Solution Testing Apparatus)

TESTERS, Emulsion & Demulsibility
Central Scientific Co.
Precision Scientific

TESTERS, Expansion
Carson Micrometer
Dietert Co.
Dillon & Co.
Exact Weight Scale Co.
Ferner Co.
Humboldt Mfg. Co.
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TESTERS, Flash Point, Abel-Pensky's (See Abel's above)

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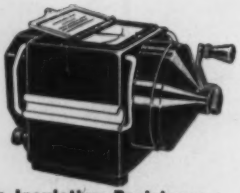
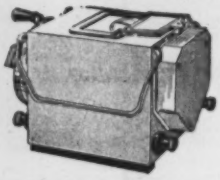
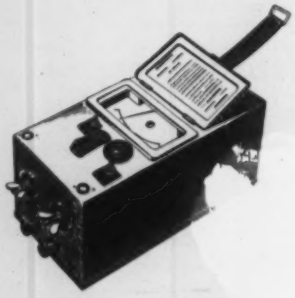


For Insulation Resistance. "Megger" Insulation Testers — Hand driven, Motor driven, "Meg," "Bridge-Meg," "Rectifier Operated" and Midget Types. *Bulletin 21P7-I*



For Ground Resistance. "Megger" and "Meg" Ground Testers. *Catalog 25-I*



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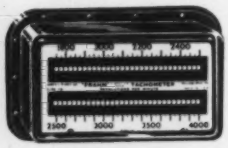
"Megger" Ohmmeters — up to 1000 megohms. *Bulletin 1540-I*

Midget "Megger" Circuit Testing Ohmmeters—0.1—200,000 ohms. *Bulletin 1495-I*



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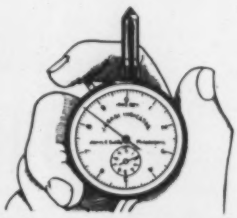
"Frahm" Vibrating Reed Tachometers and Vibration Indicators. *Bulletin 31-I*



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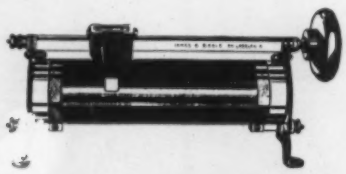

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TESTERS, Flash Point, Elliott Closed Cup
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Central Scientific Co.
Humboldt Mfg. Co.
Precision Scientific Co.
Ruehfel Co.
Tagliabue Corp., C. J.

TESTERS, Flash Point, Pensky-Martens
American Inst. Co.
Boekel & Co.
Central Scientific Co.
Humboldt Mfg. Co.
Koehler Instrument
Precision Scientific Co.
Ruehfel Co.
Tagliabue Corp., C. J.

TESTERS, Flash Point, Tag Closed
Central Scientific Co.
Humboldt Mfg. Co.
Koehler Instrument
Precision Scientific Co.
Ruehfel Co.
Tagliabue Corp., C. J.

TESTERS, Flatness, Light Wave
Acme Scientific
Baird Associates
Bausch & Lomb
Crystal Research Labs.
Fecker, J. W.
Fish-Schurman Co.
Gaertner Scientific Co.
Geophysical Inst. Co.
Howland Optical
Optron Laboratory
Scherr Co., Inc.
Sherron Metallic
Van Keuren Co.
Zeiss, Inc., Carl

TESTERS, Flourescent Lighting
Eltzen Company
Littelfuse, Inc.
Skaneateles Mfg.
Sylvania Elec. Prod.

TESTERS, Freeness
Bristol Co.
Dietert Co.
Testing Machines, Inc.
Williams Apparatus Co.

TESTERS, Fuel
American Inst. Co.
Burrell Technical Supply
Central Scientific Co.
Cuthbert Co.
Emerson Apparatus Co.
Fish-Schurman Co.
Fisher Scientific Co.
Parr Instrument Co.
Precision Scientific
Riehle Div.
Sargent & Co.
Sturtevant Mill
Testing Machines, Inc.

TESTERS Gage (See Gage Testers)

TESTERS, Gas (See Gas Analyzers)

TESTERS, Gear
Dillon & Co.
Engineering Res. & Dev.
Fellows Gear Shaper
Ferner Co.
Krouse Testing Mach.
Morse Twist Drill
Olsen Testing Mach.
Scherr Co., Inc.

TESTERS, Glue
Central Scientific Co.
Dillon & Co.
Fish-Schurman Co.
Olsen Testing Machine
Physicists Research
Thwing-Albert Inst. Co.

TESTERS, Grain
Central Scientific Co.
Cuthbert Co.
Exact Weight Scale
Gump Co.
Moist-O-Meter, Inc.
Moisture Register Co.
Newark Scale Works
Precision Scientific Co.
Seedburo Equipment
Tagliabue Corp., C. J.
Toledo Scale Co.
Troemner, Henry

TESTERS, Grease (See Grease Testing Apparatus)

TESTERS, Grinding Wheel
Olsen Testing Machine

TESTERS, Ground Resistance
Associated Research
Automatic Electric Sales
Biddle Co., Jas. G.
Borden Engineering
General Electric Co.
Geophysical Inst. Co.
Gray Instrument
Heiland Research
Industrial Insts., Inc.
Instrument Labs.
Leeds & Northrup
Miller, M. C.
Niagra Electric
Roller Smith
Sensitive Res. Inst.
Shallcross Mfg.
Sherron Metallic
Sticht & Co.
Thwing-Albert
Winslow Co.

TESTERS, Hardness of Grindable Materials
Ames Precision Machine
Ferner Co.
Gardner Laboratory
Gordon Co., Clayton S.

TESTERS, Hardness of Plastic Films
Ferner Co.
Gordon Co., Clayton S.
Munsell Color Co.
Precision Scientific
Riehle Testing Machines
Steel City Testing
Taber Instrument Co.
Testing Machines Inc.

TESTERS, High Altitude (See Chambers, Instrument Test)

TESTERS, Hydrogen - Ion (See Hydrogen-Ion Determination Instruments)

TESTERS, Insulation
Aircraft Electronics
American Transformer
Associated Research
Automatic Elec. Chicago
Biddie Co., Jas.
Clough-Brengle Co.
Cole Instrument
Communication Measurements Lab.
Freed Transformer
General Elec. Co.
General Radio Co.
Gier & Bluhm
Hewlett-Packard
Hickok Elec. Inst.
Ideal Industries, Inc.
Industrial Insts., Inc.
Islip Radio Mfg.
Kellogg Switchboard
Leeds & Northrup Co.
Miller Co., Bertrand F.
Radio Frequency Labs.
Rawson Electrical Inst.
Rubicon Co.
Scott Testers
Shallcross Mfg. Co.
Sherron Metallic
States Co.
Sticht Co.
Superior Insts.
Westinghouse Elec.
Weston Elec. Inst.
Winslow Co.

TESTERS, Insulation (Thickness)
Comtor Co.
Federal Products Corp.
General Elec. Co.

TESTERS, Jelly
Chatillon & Sons
Fish-Schurman Co.
Koehler Instrument
Precision Scientific

TESTERS, Laundering
Atlas Electric Devices

TESTERS, Magnetic
American Inst. Co.
Annis Co.
Associated Research
Baird Associates
General Elec. Co.
General Radio
Geophysical Inst. Co.
Instrument Labs.
Magnaflux Corp.
Magnetic Analysis Corp.
Pioneer Instrument
Rawson Elec. Instr. Co.
Rubicon Co.
Ruska Inst. Corp.
Sherron Metallic

TESTERS, Malt
Brabender Corp.
Rieker Instrument Co.
Seedburo Equipment

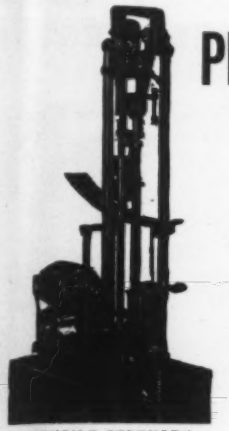
TESTERS, Mica
Boonton Radio Corp.

TESTERS, Mileage (See Meters, Mileage)

TESTERS, Milk
Central Scientific Co.
Kimble Glass
Koehler Instrument
Munsell Color Co., Inc.
Photovolt Corp.
Rieker Inst. Co.
Ruehfel Co.
Scientific Glass App.
Standard Elec. Time
Testrite Instrument Co.
Tagliabue Corp., C. J.

TESTERS, Moisture
Alpha-Lux Co.
American Inst. Co.
Brabender Corp.
Brown Inst. Div.
Cambridge Inst. Co.
Central Scientific Co.
Cuthbert Co.
Delmhorst Instrument
Dietert Co.
Electronic Products Co.
Exact Weight Scale
Ferner Co.
Fisher Scientific Co.
General Elec. Co.
Hart Moisture Gages
H & H Thermostats
Humboldt Mfg. Co.
Industrial Inst., Inc.
Laboratory Equipment
Moisture Register Co.
Precision Scientific Co.
Rascher & Betzold
Refinery Supply Co.
Scientific Glass App.
Sci. Inst. Co. (of Detroit)
Seedburo Equipment
Shallcross Mfg. Co.
Tagliabue Corp., C. J.
Tenney Engineering
Testing Machines, Inc.
Thwing-Albert Inst. Co.
Toledo Scale Co.
Troemner, Henry
Williams Apparatus Co.

PLANT and LABORATORY INSTRUMENTS



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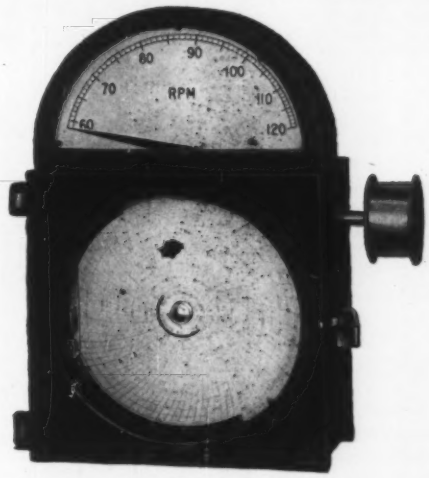

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General Radio
Hathaway Instrument
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Sheffield Corp.
Sperry Products
Thwing-Albert Inst. Co.

TESTERS, Oil
American Inst. Co.
Central Scientific Co.
Eitzen Co.
Fish-Schurman Co.
Gardner Laboratory
Hellige, Inc.
Humboldt Mfg. Co.
Kimble Glass
Koehler Instrument
Laboratory Equipment
Mico Instrument Co.
Precision Scientific Co.
Rieker Inst. Co.
Ruehfel Co.
Ruska & Co.
Scientific Glass App.
Scientific Inst. Co.
Tagliabue Corp., C. J.
Tenney Engineering

TESTERS, Oxygen
American Inst. Co.
Burrell Technical Supply
Central Scientific
General Elec. Co.
Precision Scientific
Sargent & Co.
Scientific Glass App.
Scientific Inst. Co.
Tagliabue Corp., C. J.

TESTERS, Paint
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American Inst. Co.
Atlas Elec. Devices Co.
Central Scientific Co.
Dillon & Co.
Fish-Schurman Co.
Gardner Laboratory
General Elec. Co.
Instron Engg. Corp.
Koehler Instrument
Munsell Color Co.
Photovolt Corp.
Precision Scientific
Ruehfel Co.
Scott Testers
Taber Instrument Co.
Tenney Engineering
Thermo-Electric
Van Keuren Co.
Zahr, Inc., Henry

TESTERS, Paper Curl
Thwing-Albert Inst. Co.

TESTERS, Paper Formation
Dillon & Co.
General Elec. Co.
Hart Moisture Gages
Testing Machines, Inc.
Thwing-Albert Inst. Co.
Williams Apparatus Co.

TESTERS, Paraffin
American Inst. Co.
Humboldt Mfg.
Koehler Instrument
Olsen Testing Mach.
Perkins & Son
Precision Scientific
Ruehfel Co.
Tagliabue Corp., C. J.

TESTERS, Penetration (Paper)
Olsen Testing Mach.
Testing Machines, Inc.
Thwing-Albert Inst. Co.
Williams Apparatus Co.

TESTERS, Petroleum (See Oil above)

TESTERS, Phosphate
Hellige, Inc.
La Motte Chemical Prods.
Permutit Co.
Taylor & Co., W. A.

TESTERS, Pistol Barrel Optical
Kollmorgan Optical Co.
Lenox Inst. Co.
Scherr Co., Inc.

TESTERS, Piston Ring
American Measuring Insts.
Gordon Co., Claud S.
Link Engineering
Toledo Scale Co.

TESTERS, Pitch
American Inst. Co.
Precision Scientific Co.

TESTERS, Plasticity
American Inst. Co.
Brabender Corp.
Dietert Co.
Dillon & Co.
Humboldt Mfg. Co.
Instron Eng. Corp.
Olsen Testing Machine
Precision Scientific Co.
Scott Testers, Inc.
Steel City Testing
Testing Machines, Inc.

TESTERS, Porosity
Ferner Co.
Gurley, W. & L. E.
Magnaflux Corp.
Perkins & Son
Precision Scientific
Ruska Instrument
Saxl Instrument
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Testing Machines, Inc.
Thwing-Albert Inst. Co.
Westinghouse Elec.
Williams Apparatus Co.

TESTERS, Pulp
Hart Moisture Gage
Perkins & Son
Testing Machines, Inc.
Thwing-Albert Inst. Co.
Williams Apparatus Co.

TESTERS, Radio Set (See Analyzers, Radio Set)

TESTERS, Radio Tube (See Analyzers, Radio Set)

TESTERS, Resistance
Assembly Products
Associated Research, Inc.
Automatic Elec. Chicago
Biddle Co., James G.
Borden Engineering
Cole Instrument
Communication Meas. Lab.
Dale Instruments
Electro-Tech Equipment
Electronic Dev. Lab.
Freed Transformer
General Elec. Co.
General Radio Co.
Gray Instrument Co.
Ideal Industries, Inc.
Industrial Instruments
Instrument Labs.
Leeds & Northrup Co.
National Tech. Labs.
Nosker Eng. Prod.
Radex Corp.
RCA Manufacturing
Rubicon Co.
Shallcross Mfg. Co.
Sticht Co.
Supreme Instrument Corp.
Sylvania Elec. Prod.
Triplett Electrical Inst.
Westinghouse Elec.
Weston Electrical Inst.

TESTERS, Salt Spray
American Instrument Co.
Atlas Electric Devices
Industrial Filter

TESTERS, Sand
Chatillon & Sons
Dietert Co.
Exact Weight Scale Co.
Hart Moisture Gage
Humboldt Mfg. Co.
Precision Scientific

TESTERS, Slowness
Testing Machines, Inc.
Williams Apparatus Co.

TESTERS, Softness
Dillon & Co.
Ferner Co.
Gurley, W. & L. E.
Humboldt Mfg. Co.
(Continued)

Olsen Testing Mach.
Precision Scientific
Taber Instrument Co.
Thwing-Albert Inst. Co.

TESTERS, Spark Plug
Centralab Div.
Cole Instrument
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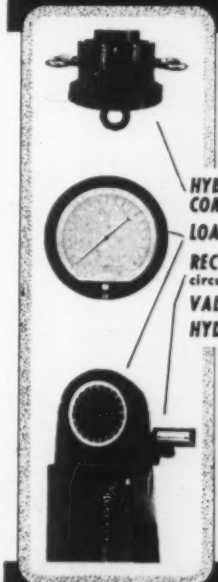

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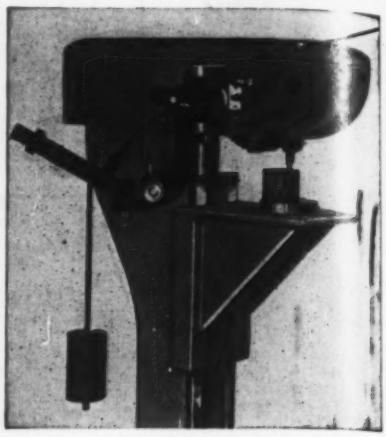

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Ipstron Eng. Corp.
Krouse Testing Mach.
Morehouse Mach. Co.
Norcross Corp.
Olsen Testing Machine
Riehle Testing Machines
Rubicon Co.
Scott Testers, Inc.
Steel City Testing
Tabor Instrument Co.
Thwing-Albert Inst. Co.

TESTING MACHINES, Yarn
Atlas Elec. Devices Co.
Brown Inst. Div.
Chatillon & Son
Dillon & Co.
Emerson Apparatus Co.
Hart Moisture Gage
Instron Eng. Corp.
Olsen Testing Mach.
Saxl Instrument
Schaevitz Engineering
Scott Testers, Inc.
Suter, Alfred
Testing Machines, Inc.
Thwing-Albert Inst. Co.

TESTING SETS (See also object of measurement and control)

TESTING SETS, Alcohol
Fischer & Porter
G. M. Mfg. Co., Inc.
Griebel Co.
Precision Therm.
Roecher & Betzold
Ruehfel Co.
Scientific Glass App.
Tagliabue Corp., C. J.
Weksler Thermometer

TESTING SETS, Automotive
Clough-Brengle Co.
Englehard Chas.
Gow-Mac Instrument
Hays Corp.
Neihoff & Co.
Potter Co.
Westberg Mfg. Co.

TESTING SETS, Cable
Automatic Elec. Chicago
Biddle Co., James G.
Century Geophysical
Communication Meas. Lab.
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Eastern Specialty
General Elec. Co.
General Radio Co.
Leeds & Northrup
Littlefuse, Inc.
Rubicon Co.
Shallcross Mfg.
Sherron Metallic
Westinghouse Elec.
Winslow Co.

TESTING SETS, Communication Circuits
Automatic Elec. Chicago
Bell & Howell
Clough-Brengle
Collins Radio Co.
Daven Co.
Electronic Dec. Lab.
Electro Products Labs.
Freed Transformer
Hewlett-Packard
Kellogg Switchboard
Leeds & Northrup
Littlefuse, Inc.
Meters, Inc.
Precision Apparatus
Radio City Products
Reiner Electronics
Rubicon Co.
Shallcross Mfg.
Sherron Metallic
Sylvania Elec. Prod.
Technology Inst. Corp.
Weston Elec. Inst. Corp.
Winslow Co.

TESTING SETS, Current Transformer
Assembly Products
Elec. Facilities Inc.
Federal Telegraph Co.
General Electric Co.
Leeds & Northrup
Rubicon Co.
Sherron Metallic
States Co.
Thordarson Elec. Mfg.

TESTING SETS, Electrical
American Transformer
Associated Research
Automatic Elec. Chicago
Biddle Co., James G.
Bradshaw Instruments
Clarke Inst. Corp.
Clough-Brengle Co.
Columbia Elec. Mfg.
Communication Meas. Lab.
Dale Instruments
Eastern Specialty
Elec. Facilities, Inc.
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Esterline-Angus
Feiler Engineering
General Elec. Co.
Gray Instrument
Hewlett-Packard
Industrial Inst., Inc.
Link Engineering
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Potter Instrument
Precision Apparatus
Rawson Elec. Inst. Co.
RCA Mfg. Co.
Roller-Smith Co.
Rubicon Co.
Sensitive Research Inst.
Shallcross Mfg. Co
Sherron Metallic
Sticht Co
Superior Electric Co
Tobe Deutschmann Corp.
Triplett Elec. Inst.
Westinghouse Elec.
Weston Elec. Inst. Corp.
Winslow Co.

TESTING SETS, Electrical Thermometer
Brown Inst. Div.
Gray Instrument
Leeds & Northrup
Rubicon Co.
Shallcross Mfg. Co.
Sherron Metallic
Tagliabue Corp., C. J.
Thwing-Albert Instrument
Winslow Co.

TESTING SETS, Ground Resistance (See Tester, Ground Resistance)

TESTING SETS, Insulation, (see Testers, Insulation)

TESTING SETS, Line Current
Associated Research
Automatic Elec. Chicago
Cole Instrument
Columbia Elec. Mfg.
Elec. Facilities, Inc.
Electronic Development
Esterline Angus
General Elec. Co.
Gray Instrument
Hickok Elec. Inst.
Meter Devices Co.
Precision Apparatus
Roller-Smith
Rubicon Co.
Sherron Metallic
Sticht Co.
Triplett Elec. Inst.
Weston Elec. Inst. Corp.

TESTING SETS, Meters, Electrical
Assembly Products
Associated Research
Automatic Elec. Chicago
Booth Co., Arthur H.
Chicago Indust. Inst.
Clippard Inst. Lab.
Clough-Brengle Co.
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Triplett Elec. Inst.
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Fischer & Porter
Tagliabue Corp., C. J.

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Engelhard, Chas.
Hays Corp.

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Eastern Specialty Co.
Elec. Facilities, Inc.
General Elec. Co.
Leeds & Northrup Co.
Raytheon Mfg. Co.
Sherron Metallic

TESTING SETS, Surface Roughness
Surface Checking Gage

TESTING SETS, Telephone
Automatic Elec. Chicago
Bradshaw Instruments
Daven Co.
Electronic Development
Federal Telegraph Co.
Kellogg Switchboard
Rubicon Co.
Shallcross Mfg. Co.
Sherron Metallic
Technology Instrument

TESTING SETS, Water
Barnstead Still
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Taylor & Co., W. A.

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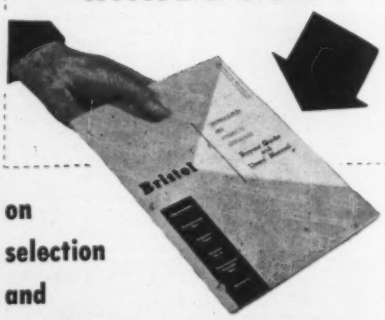

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Foxboro Co.
General Controls
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Gordon Co., Claud S.
Ill. Testing Labs.
Industrol Corp.
J-B-T Insts. Inc.
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Tagliabue Corp., C. J.
Taylor Inst. Cos.
Thwing-Albert Instrument
Westinghouse Elec.
Wheelco Inst. Co.
Winslow Co.

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Bailey Meter Co.
Bristol Co.
Cambridge Inst. Co.
Campell Co., J. A.
Cole Instrument
De Jur-Amsco
Elematic Equip. Corp.
General Controls Co.
Gordon Co., Claud S.
Hickok Elec. Inst. Co.
Ill. Testing Labs.
J-B-T Instruments
Lewis Engg. Co.
Precision Tube Co.
Pyrometer Instrument
Pyrometer Service Co.
Revere Corp.
Rowe Engineering
Sensitive Research Inst.
Taco West Corp.
Tagliabue Corp., C. J.
Thermo-Electric Co.
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Wheelco Inst. Co.
Winslow Co.

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THERMOCOUPLES, Separate Heater Type
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General Controls
General Elec. Co.
General Radio Co.
Illinois Testing Labs.
Sensitive Research Inst.
Taco West Corp.
Wheelco Insts. Co.

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Ballantine Labs.
Biddle Co.
Cambridge Inst. Co.
Cole Instrument
Distillation Products
Farrand Optical
Fredericks Co., George
Field Electric
General Elec. Co.
General Radio Co.
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Hickok Elec. Inst. Co.
National Research
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THERMOMETER TESTERS (See Testers, Thermometer)

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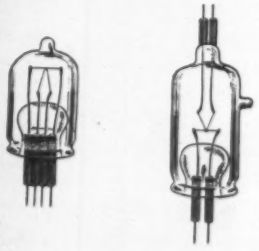

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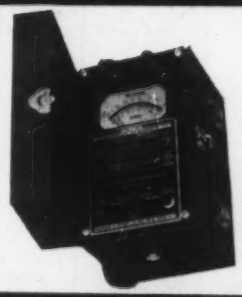

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Weiler, Paul G.
Wheelco Inst. Co.
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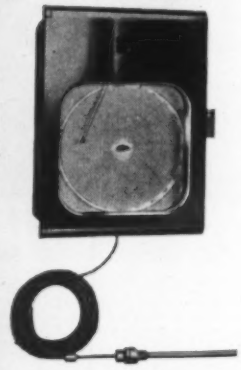

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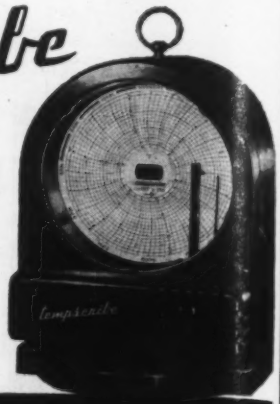

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−30° to +120° F	24 Hours
−20° to + 40° F	24 Hours
−10° to + 50° F	7 Days
−10° to + 30° F	24 Hours
30° to 60° F	24 Hours
40° to 100° F	7 Days
40° to 100° F	24 Hours
60° to 90° F	24 Hours
60° to 90° F	8 Hours
70° to 130° F	24 Hours
70° to 130° F	8 Hours
100° to 160° F	4 Hours
−25° to + 10° C	24 Hours
5° to 40° C	24 Hours

RECORDING THERMOMETER

The TEMPSCRIBE self-registering Recording Thermometer meets a long-felt need for a moderately priced recorder for general purpose applications where a graphic record of temperature in surrounding air is required. The record—written on an easy-to-read chart, 4" in diameter, with graduations spaced uniformly over full range—is indispensable wherever knowledge is desired if temperature goes above or below any given point. TEMPSCRIBE is the only recorder made with pen and actuating element in door, which, when opened, permits a clear view of the complete chart, and easy chart replacement without danger of damaging pen arm or accidentally marking chart.

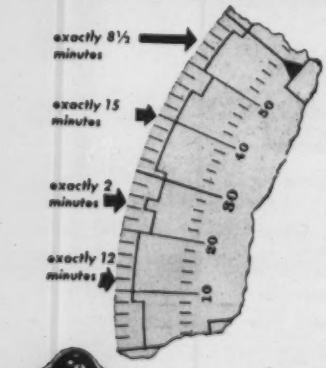
MOTOR OPERATION RECORDER ALSO AVAILABLE

for recording any cycle carried out by interrupting an electric current, such as starting and stopping motor, fan, heater, sign, etc.

Write for Bulletin 715

BACHARACH INDUSTRIAL INSTRUMENT CO.
7000 Bennett Street · Pittsburgh 8, Pa.

Process Timing



Bolt this 2 lb. Recorder right to the machine itself; Let the "Process" record itself on the chart —(No ink, no pencil, no wires; the record is recorded in wax).

"The cure must be 8½ minutes"—"the heat must be applied exactly 15 minutes"—"the plating must take just 2 minutes"—"the pigment must be mixed just 12 minutes"—etc.

The *Servis Recorder* checks on this—it records just what happened—it "*times the process.*" You are no longer in the dark; from now on you know all day and every day whether your *process timing* is lived up to—or if somebody slipped—if something went wrong to ruin your product for that afternoon, or that whole shift! Write for Process Timing Catalog. The Service Recorder Co., 1375 Euclid Avenue, Cleveland 15, Ohio.

The Servis Recorder
The Time Clock for Machinery

Manning, Maxwell & Moore
Marsh Corp.
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Partlow Corp.
Penn Ind. Inst. Corp.
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Tagliabue Corp., C. J.
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Green, Henry J.
H-B Instrument
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(Continued)

MARSH Dial Thermometers

Rigid Stem Type —

A dial thermometer that gives highly accurate temperature indication at the point of measurement. The remarkably sensitive bi-metal coil responds rapidly to any temperature. Ranges for practically all services.

Remote Reading Type —

A dial thermometer that provides temperature readings from distant or otherwise inaccessible points of measurement. Operates on vapor tension and can therefore be supplied with exexteremly long connecting tubing. Temperature ranges for practically all services.

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THERMO-VOLTMETERS (See Voltmeters, Thermo)

THERMOWELLS (See Thermometer Test Wells)

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Tagliabue Corp., C. J.
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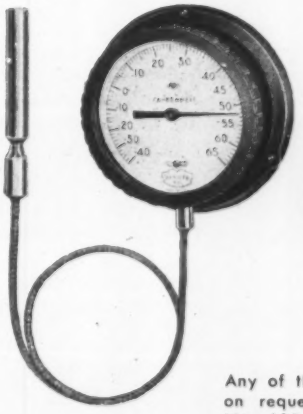
Our facilities are at your disposal. We can promptly fill your requirements for all types of Thermometers, Hydrometers, Hygrometers, Psychrometers and Gauges.

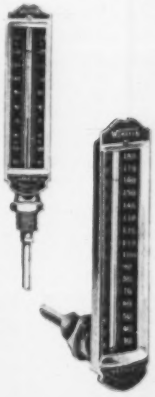
INDUSTRIAL THERMOMETERS, in "V" shaped bronze cases, are supplied with Yellow Back or Red Reading Mercury tubes.

DIAL THERMOMETERS, in phenolic, aluminum and brass cases, are supplied in 3½", 4½", 6" and 8½" dial sizes, mercury or vapor actuated.

TEMPERATURE AND PRESSURE RECORDERS in aluminum cases, are supplied in 8", 10" and 12" chart sizes, mercury actuated.

GAUGES for standard services, are supplied in 3½", 4½", 6" and 8½" dial sizes.





Any of the following Catalogues sent on request: Industrial Thermometers No. 125; Dial and Recording Thermometers No. 320; Dial and Recording Pressure Gauges No. 520.

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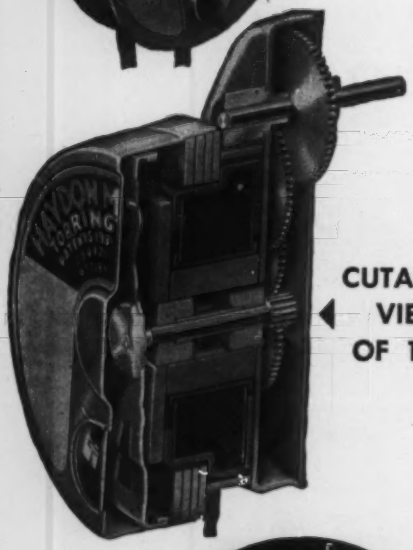
TIMING MOTORS

WHEN IT'S TIME FOR TIMING

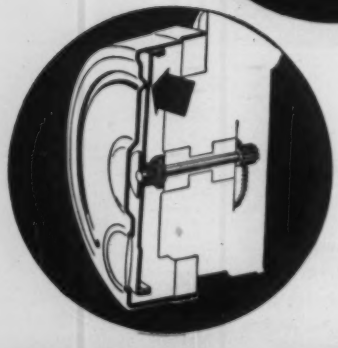
RELY ON HAYDON FOR QUALITY

◀ 1600



◀ CUTAWAY VIEW OF 1600

SHIFT UNIT ▶



◀ BRAKE UNIT

1600 SERIES

The 1600 series motor and gear train is the most versatile and popular in the Haydon line. The gear housing is sealed against dirt and moisture, and contains a capillary lubricating system. This design is adaptable to almost every application, permits mounting in any position, and is available in speed as slow as 1 revolution in 4 hours.

STANDARD SPECIFICATIONS

SPEEDS: 1/240, 1/120, 1/60, 1/45, 1/30, 1/15, 1/10, 1/6, 1/5, 1/4, 1/3, 1/2, 1, 2, 4, 5, 10, 30, 60 rpm
SHIFT: Available 1/10, 1/5, 1 and 4 rpm
VOLTAGE: 110, 220V
FREQUENCY: 60, 50, 25 cps
SHAFT: #16-3186, 1/8" diameter x 3/8" long
FRICTIONS: Available speeds of 15 rpm and slower
LEADS: 6 inch
TORQUE: 5 ounce inches @ 1 rpm (60 cps, 2.3W); maximum torque load for standard gear trains 20 ounce inches.

SPECIAL SPECIFICATIONS

Many other variations available in quantities of 100 or more, including brake and anti-backlash construction, 60 speeds from 1/180 to 300 rpm, shift feature in 33 additional speeds from 1/9 to 15 rpm, special shafts, pinions, voltages, frequencies, etc.

THE INSIDE STORY

The cut-away view illustrates some of the many quality features of the 1600 series, and all Haydon synchronous motors.

Patented shading coil construction gives high starting torque • Patented field structure gives balanced torque characteristics • Porous bronze graphite bearings filter lubricant to bearing surfaces • Shaft housing seals lubricant away from motor shaft, prevents pumping • Sealed reservoir for motor shaft lubrication • Motor completely enclosed • Patented uniform reluctance rotor ring for uniform torque characteristics, rigidly held by spunover support • Double bronze bearings on output shaft • Lubricant carried by capillary attraction to each gear assembly individually, irrespective of mounting position of unit • Coil protected against voltage surges with fold of insulation • Gears are not "drowned" in bath of oil. Oil will not leak out regardless of mounting position • Coil tested for 2000 VAC breakdown • Projection-welded field assures accurate air gap and rugged construction.

SHIFT UNIT FOR AUTOMATIC RESET

To provide immediate automatic resetting for devices, Haydon can incorporate a shift mechanism in the 1600 series motor and gear unit. The magnetic pull of the energized motor field is utilized to engage the gear train while the timing operation is in progress. A counterbalance in the shift disengages the gear train from the motor when the motor field is de-energized. The drive shaft is then free to be reset to its starting position by means of an external spring. Engaging and disengaging action is uniform in any position.

BRAKE UNIT FOR INSTANT STOP

A magnetic brake is provided in the Haydon 1600 series motor and gear unit, where extreme accuracy must be maintained to avoid accumulative errors. The brake stops the rotor instantly by bringing it in direct spot contact with the motor housing. Coasting is eliminated after current is turned off to assure positive performance.

HAYDON Manufacturing Company, Inc.

Subsidiary of GENERAL TIME Instruments Corporation

IT'S TIME FOR HAYDON

PERFORMANCE and FLEXIBILITY

TIMING MOTORS

3100 SERIES

This series consists of the basic Haydon motor and heavy duty gear train, for applications requiring higher torque at slow output speeds, and is particularly suitable as a chart drive in recording and controlling instruments.

STANDARD SPECIFICATIONS

SPEEDS: 1 and 12 hours, 1, 7 and 14 days per revolution
VOLTAGE: 115v standard; 230v to order
FREQUENCY: 60, 50, 25 cps
SHAFT: #2170, 3/16" dia. x 3/8" long, with .162" dia. flat
LEADS: 12 inch
TORQUE: 15 pound inches @ 1 rph (60 cps, 2.5w) is maximum torque load

SPECIAL SPECIFICATIONS

Many additional features available in quantities of 100 or more, including 46 speeds from 6 seconds to 8 days per revolution, anti-backlash and brake construction, frictions, special voltages, frequencies, etc.

4400 SERIES

A new slow-speed motor series for general timing applications. with a single deep gear cup and other new design elements which make it possible to offer considerably lower costs in a limited number of speeds. The 4100 series is still available for other speeds.

STANDARD SPECIFICATIONS

SPEEDS: 12 hours, 1 and 7 days per revolution
VOLTAGE: 115v standard; 230v to order
FREQUENCY: 60, 50, 25 cps
SHAFT: #16-3186, 1/8" dia. x 3/8" long
FRICTIONS: Available all speeds
LEADS: 6 inch
TORQUE: 20 ounce inches at all speeds

SPECIAL SPECIFICATIONS

Many other variations available in quantities of 100 or more, including 12 speeds from 5 to 1000 hours per revolution in 4100 series, special shafts, pinions, voltages, frequencies, etc.

FRICTIONS

Both one-way and two-way frictions for manual setting of the shaft independent of the motor are available. A variety of torque ratings is available in the two-way frictions.

ENGINEERING CATALOG

A complete Haydon catalog is available to you without charge or obligation. Keep one in your files for handy reference. It contains photographs, drawings, descriptions and application information on the 1600, 3100, 4100, 4400 motors, and 6 other motor series. Write for this engineering data catalog today.

WRITE 649 ELM STREET, TORRINGTON, CONNECTICUT

Torrington, Connecticut

Harness Time to Your Products

Standard TIMERS

WORLD'S MOST ACCURATE AND RUGGED TIME MEASURING INSTRUMENT. CAN BE MANUALLY OR ELECTRICALLY OPERATED. FURNISHED IN PORTABLE CASES OR FOR PANEL MOUNTING.

T-1

Model	Reads	Totalizes	Accuracy
S-100	1/5 sec.	6000 sec.	±.1 sec.
S-60	1/5 sec.	60 min.	±.1 sec.
SM-60	1/100 min.	60 min.	±.00⅔ min.
S-10	1/10 sec.	1000 sec.	±.0⅔ sec.
S-6	1/1000 min.	10 min.	±.000⅔ min.
S-1	1/100 sec.	60 sec.	±.01 sec.
MST	1/1000 sec.	.360 sec.	±.001 sec.
MST-500	1/1000 sec.	30 sec.	±.00⅔ sec.

WRITE FOR BULLETIN 153

also Standard Chrono-Tachometers • Standard Custom-built Laboratory Test and Distribution panels

THE Standard Electric Time Co.

93 Logan Street STANDARD FOUNDED 1884 **Springfield, Mass.**

Industrol Instrument Air Dehumidifiers

AIR that is CLEAN, OIL & MOISTURE FREE is the first prerequisite to dependable instrument operation

The INDUSTROL Dual Tower Dehumidifiers have been designed by INSTRUMENT ENGINEERS who thoroughly understand the problem of instrument air systems.

INDUSTROL offers a complete pneumatic steam reactivated model which requires **no electricity** and is especially adapted for service in HAZARDOUS LOCATIONS.

Electric models are also offered in Class 1, Group D construction

Fully automatic units are available from 25-1000 S.C.F.M.

Write for Bulletin DD-100

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Anderson, A. & J. M.
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Automatic Elec. Mfg.
Automatic Temp. Control
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Bristol Co.
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Thordarson Elec. Mfg.
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Walser Automatic Timer
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Abrams Instrument
Alfax Paper & Eng.
American Time Corp.
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Telechron Inc.
Thompson Clock
Tork Clock Co.
Wallace & Tiernan
Weston Elec. Inst. Corp.
Wilson & Co.

TIMERS, AUTOMATIC, Spot Weld
Allen-Bradley Co.
Am. Gas Accumulator
Automatic Temp. Control
Booth Co., Arthur E.
Cramer & Co., Inc.
Cutler-Hammer, Inc.
Electronic Controls
Electronic Prod. Co.
Electyme Motor Prods.
General Electric Co.
Industrial Timer
National Time & Signal
Photoswitch Inc.
Photovolt Corp.
Weltronic Co.
Wilson & Co., G. C.

TITRATION APPARATUS, Electrometric
Burrell Technical Supply
Cambridge Instrument Co.
Central Scientific Co.
Coleman Electric Co.
Fisher Scientific Co.
Gray Instrument
Leeds & Northrup Co.
National Technical Labs
Pfaltz & Bauer
Precision Scientific
Rubicon Co.
Sargent & Co., E. H.
Thomas Co., Arthur H.
Welch Mfg. Co.

TOOLMAKER'S FLATS see Flats, Optical

TOOLS, Precision
Bayside Watch Tool
Fonda Gage Co.
Gustafson Mfg. Co.
Jenckes Knitting Mach.
Levin & Son
Lufkin Rule Co.
Marshall Co.
Swanson Tool Mach.

TOPOGRAPHIC INSTRUMENTS (See Surveying Instruments)

TORQUE GAGES (See Gages, Torque)

TORQUE MEASURING EQUIPMENT
Airdraulics Engineering
Emery Co., A. H.
Flight Research Eng.
General Elec. Co.
Hagan Corp.
Hathaway Instrument
Martin-Hubbard Corp.
Saxl Instrument
Skyway Prec. Tool
Sturtevant Co.
Trimount Inst. Co.

TORSIOGRAPH
Baldwin Locomotive
Commercial Research
Consolidated Engg.
Saxl Instrument
Toledo Scale Co.

TORSION METERS
Airdraulics Engineering
Boulin Inst. Corp.
Chatillon & Sons
Commercial Research
Hathaway Inst. Co.
Riehle Testing Machines
Saxl Instrument
Toledo Scale Co.

TOTALIZERS, Demand
American Meter Co.
General Elec. Co.
Landis & Gyr
Leeds & Northrup
Sargamo Electric
Westinghouse Elec.

TOTALIZERS, Electric Energy
Autocall Co.
Automatic Elec. Chicago
Bristol Co.
Esterline Angus Co.
General Elec. Co.
Landis & Gyr. Inc.
Leeds & Northrup
Sangamo Electric
Westinghouse Elec.

TOTALIZERS, Fluid Flow
American Meter Co.
Askania Regulator Co.
Bailey Meter Co.
Bristol Co.
Brooks Rotameter
Brown Instrument Div.
Builders-Providence
Fischer & Porter
Foxboro Co.
General Elec. Co.
Hagan Corp.
Hays Corp.
Henszey Co.
Leeds & Northrup Co.
Leupold & Stevens
Mason-Neilan Regulator
Penn Ind. Inst. Corp.
Republic Flow Meters
Revere Corp.
Simplex Valve & Meter
Smith Meter
Sparling, R. W.
Tagliabue Corp., C. J.
Taylor Inst. Cos.

TOTALIZERS, Gas Flow
American Meter Co.
Bailey Meter Co.
Bristol Co.
Builders-Providence
Fischer & Porter
Foxboro Co.
Hagan Corp.
Hays Corp.
Penn Ind. Inst. Corp.
Republic Flow Meters
Simplex Valve & Meter

TOTALIZERS, Running Time
Aero Instrument Co.
Bristol Co.
Cramer Co., Inc.
Elec. Tachometer Corp.
Gorrell & Gorrell
Industrial Timer Corp.
Photoswitch, Inc.
Production Instrument
Standard Elec. Time
Westinghouse Elec. & Mfg.

TRAFFIC SIGNALLING DEVICES (See Signaling Devices, Traffic)

TRAMMELS, Steel Beam
Lufkin Rule Co.
Union Tool Co.

TRANSFORMERS, Adjustable
Airdestern, Inc.
Allied Control Co.
American Transformer
Freed Transformer
General Radio Co.
Gulow Corp.
Hevi Duty Elec.
Lindberg Engineering
Merit Coil & Transformer
Miller Transformer
Raytheon Mfg. Co.
Sorensen & Co.
Superior Electric Co.
Thordarson Elec. Mfg. Co.
United Transformer

TRANSFORMERS, Constant Voltage
Airdesign, Inc.
Better Coils Inc.
Chicago Electronic
Cole Instrument
General Controls
General Electric Co.
Hevi-Duty Elec.
Miller Transformer
Perfex Corp.
Sola Electric Co.
Sorensen & Co.
(Continued)

Standard Transformer
Superior Electric Co.
Thordarson Elec. Mfg.
United Transformer
Westinghouse Elec.

TRANSFORMERS Experimenter's Variable Voltage
Airdesign, Inc.
Allied Control Co.
American Transformer
Better Coils Inc.
Chicago Electronic
DoAll Co.
Dongan Electric Co.
Freed Transformer
General Controls
General Radio Co.
Gulow Corp.
Hevi-Duty Elec.
Merit Coil & Transformer
Miller Transformer
Raytheon Mfg.
Sorensen & Co.
Standard Transformer
Sorvall, Ivan
Southwestern Ind. Elec.
Superior Electric Co.
Thordarson Elec. Mfg.
United Transformer
Walker-Jimieson, Inc.

TRANSFORMERS, Impedance
Better Coils, Inc.
Freed Transformer Co.
General Electric Co.
Merit Coil & Trans.
Miller Transformer
Raytheon Mfg. Co.
Southwestern Ind. Elec.
Sperry Gyroscope Co.
Standard Transformer
Sorenson & Co.

TRANSFORMERS, Instrument
Airdesign, Inc.
Allied Control Co.
Allis-Chalmers
Amplifier Co.
Annis Co.
Assembly Products
Associated Research
Audio Development
Better Coils, Inc.
Burlington Inst. Co.
Chicago Electronic
Chicago Transformer
Cole Instrument
Columbia Elec. Mfg.
Control Corp.
Dongan Electric Mfg.
Eastern Specialty Co.
Eclipse-Pioneer Div.
Elec. Facilities, Inc.
Esterline Angus Co.
Federal Telegraph Co.
Freed Transformer
Friez Instrument
General Controls
General Elec. Co.
Gulow Corp.
Hagan Corp.
Hickok Elec. Inst. Co.
Industrial Insts. Inc.
Kollsman Inst. Div.
Leukurt Electric Co.
Manning, Maxwell, Moore
Merit Coil & Trans.
Miller Transformer
New York Transformer
Roller-Smith Co.
Sangamo Electric Co.
Simpson Electric Co.
Sorensen & Co.
Southwestern Inc. Elec.
Sperry Gyroscope Co.
Standard Science Sup.
Stict Co.
Superior Electric Co.
Thordarson Elec. Co.
Utah Radio Produs.
United Transformer Corp.
Westinghouse Elec.
Weston Elec. Inst. Corp.

TRANSFORMERS, Insulation Testing
Airdesign, Inc.
American Transformer
Amplifier Co.
Associated Research
Better Coils, Inc.
Campbell Electric
Chicago Electronic
Cole Instrument
Dongan Electric Mfg.
Freed Transformer
General Controls
General Elec. Co.
Leukurt Electric Co.
Merit Coil & Trans.
Miller Transformer
Raytheon Mfg. Co.
Sherron Metallic
Superior Electric Co.
Thordarson Elec. Mfg.
United Transformer

TRANSFORMERS, Laboratory
Airdesign, Inc.
Allied Control Co.
American Inst. Co.
American Transformer
Amplifier Co.
Audio Development
Better Coils, Inc.
Burrell Tech. Supply
Central Scientific Co.
Chicago Electronic
Chicago Transformer
Clough-Brengle Co.
Daven Co.
Dongan Electric Mfg.
Eastern Specialty Co.
Elec. Facilities, Inc.
Electro-Tech Equip. Co.
Ferranti Electric
Freed Transformer
(Continued)

Cramer SELF-STARTING SYNCHRONOUS TIMING MOTOR

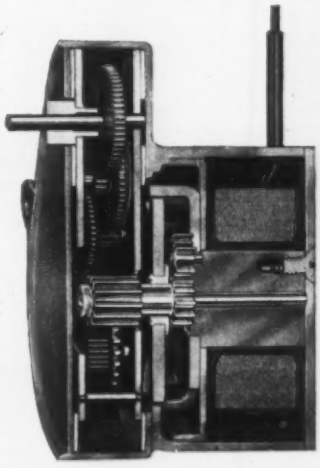
TYPE SX

The Cramer Type SX Synchronous Motor is a permanent magnet type motor. By reason of careful design these motors are highly efficient and produce an exceptionally high torque for such small space and wattage requirements. They are self-starting, run at slow speed . . . 240 RPM at 60 Cycle . . . and operate in any position. They will operate at synchronous speed only and will start in 2 cycles and stop within 1/25 seconds.

APPLICATIONS . . . Primarily intended for applications requiring constant speed at a given frequency, this motor is particularly suited for: Timing Devices — Recording Instruments — Communications Equipment — Traffic Controls — Advertising Displays — Clocks — Heating Controls — Signaling Systems.

IMPORTANT FEATURES . . . *Truly Synchronous:* A truly synchronous type utilizing a strong permanent magnet rotor which draws no energy from the A.C. field. Impossible for the motor either to overspeed or underspeed. *High Torque:* 30 inch ounces at 1 RPM, 60 Cycles. *High Efficiency:* At least 5 times greater than a hysteresis shaded pole type motor of equivalent dimensions. *Controlled Rotation:* An exclusive feature determines direction of rotation. Clockwise or counterclockwise motor can be supplied. *Speed:* 28 standard gear trains, ranging in speeds from 60 RPM to 1 revolution in 24 hours are available. *Lubrication:* A special high grade lubricant is sealed within the housing containing the rotor gear train and provides adequate lubrication for many years of service. *Replaceable Coils:* Coils are easily removable thereby facilitating changes in the voltage rating or in field servicing. *One- or Two-Way Friction:* The latter permits the drive shaft to be turned in either direction independent of the gear train or motor.

CONSTRUCTION . . . Iron circuit of the motor provides a cup for the motor coil and serves as a base to which gear housing is assembled. A complete, interchangeable gear train with a substantial oversize bearing snugly fits into the gear housing. Two substantial lugs extending from the gear housing provide convenient mounting means. For complete details ask for Bulletin 10A.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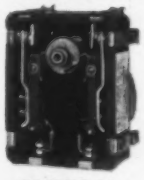
CRAMER SYNCHRONOUS ELECTRIC TIMERS

(A) INTERVAL TIMERS

(B) AUTOMATIC RESET TIMERS

(C) TIME DELAY RELAYS


(D) TYPE TC

(E) TYPE TD5

(F) PERCENTAGE TIMERS

(H) MULTI-CONTACT CAM TIMERS

(G) MULTI-CONTACT TIMERS

RUNNING TIME METERS

(I) RUNNING TIME METERS

(A) INTERVAL TIMERS . . . Manually set for each operation. Designed to automatically open or close a single circuit at the end of a definite time interval, or to automatically close one circuit and open second at end of a definite time interval. Ask for Bulletin 100F.

(B) AUTOMATIC RESET TIMERS . . . To close or open a circuit after an adjustable pre-set time and instantly return to the starting position ready to repeat this cycle of operation upon reclosure of the starting button. Ask for Bulletin 500B.

(C) TIME DELAY RELAYS (Type TEC) . . . Provides adjustable or fixed time delay between closing and opening of a load circuit. Has automatic re-set feature which restores timer to its normal starting position when control circuit fails or is de-energized. Also available with reverse clutch which prevents re-set in case of power failure. Ask for Bulletin 800D.

(D) TYPE TC . . . Inexpensive single and two pole time delay relay. Ask for Bulletin 900D.

(E) TYPE TD5 . . . One of many special types available with overtravel contacts to provide shock-resistance.

(F) PERCENTAGE TIMERS: Automatically controls the percentage of time at which circuit can be closed or opened out of a definite length of time. Distinctive feature: Utmost simplicity of design. Adjusted from the front, can be set from 5% to 97% of total cycle. Ask for Bulletin 2500C.

(G) MULTI-CONTACT TIMERS: Automatically controls a sequence of "on" and "off" operations of a single or multiple number of electrical circuits in accordance with a predetermined operating program. They can (1) repeat continuously, or (2) automatically stop after one complete operation. Ask for Bulletin 3000A.

(H) Simple Low Priced Single or Multi-Contact Cam Timers for built-in applications.

(I) RUNNING TIME METERS: Synchronous motor driven running time meters, automatically and cumulatively register the total operating time or idle time on any circuit, machine or system to which they are connected. Are available in table model also. Ask for Bulletin 3500B.

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CENTERBROOK CONNECTICUT

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Hevi Duty Elec.
Hickok Elect. Inst.
Laboratory Equip. Corp.
Leukurt Electric Co.
Merit Coil & Trans.
Miller Transformer
New York Transformer
Raytheon Mfg. Co.
Scientific Glass App.
Sola Electric Co.
Sorenson & Co.
Southwestern Ind. Elec.
Standard Elec. Prod.
Standard Transformer
Superior Electric Co.
Thordarson Elec. Co.
United Transformer Corp.
Westinghouse Elec.
Weston Elec. Inst. Corp.

TRANSFORMERS, Microwave
Better Coils, Inc.
Freed Transformer
General Electric Co.
Raytheon Mfg. Co.
Sperry Gyroscope Co.
Sorensen & Co.

TRANSFORMERS, Phasing
Airdesign, Inc.
Better Coils, Inc.
Chicago Electronic
Dongan Electric Mfg.
Eastern Specialty Co.
Esterline Angus
Freed Transformer
General Elec. Co.
Merit Coil & Trans.
New York Transformer
Raytheon Mfg. Co.
States Co.
Thordarson Mfg. Co.
United Transformer Corp.
Westinghouse Elec.

TRANSFORMERS, Power
Airdesign, Inc.
Allied Control Co.
Allis-Chalmers
American Transformer
Amplifier Co.
Audio Development
Better Coils, Inc.
Chicago Electronic
Chicago Transformer
Dongan Elec. Mfg.
Eclipse-Pioneer Div.
Federal Telegraph Co.
Ferranti Electric
Freed Transformer
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WRITE FOR CATALOG No. 8000

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Gulow Corp.
Harvey Radio Labs.
Heri Duty Electric
Ilslip Radio Mfg.
Leakurt Electric Co.
Lindberg Engineering
Merit Coil & Trans.
Miller Transformer
New York Transformer
Sampsel Time Control
Sola Electric Co.
Sorensen & Co.
Standard Transformer
Superior Electric
Thermador Elec.
Thordarson Elec. Mfg.
United Transformer
Weston Elec. Inst.

TRANSFORMERS, Split Core
Airdesign, Inc.
Allied Radio Corp.
Annis Co.
Assembly Products
Better Coils, Inc.
Chicago Electronic
Cole Instrument
Elec. Facilities, Inc.
Esterline-Angus Co.
Freed Transformer
General Elec. Co.
H-D Elec. Co.
Ilslip Radio Mfg.
Roller-Smith Co.
Rubicon Co.
Sangamo Electric Co.
Sorensen & Co.
Thordarson Elec. Co.
United Transformer Corp.
Westinghouse Elec.

TRANSFORMERS, Variable Voltage Testing
Airdesign, Inc.
Allied Control Co.
American Transformer
Better Coils, Inc.
Chicago Electronic
Dongan Electric Mfg.
Federal Telegraph Co.
Freed Transformer
General Electric Co.
General Radio Co.
Gulow Corp.
Merit Coil & Trans.
Miller Transformer
Raytheon Mfg. Co.
Sorensen & Co.
Standard Transformer
States Company
Superior Electric Co.
Thordarson Elec. Mfg.
United Transformer

TRANSFORMERS, Voltage Regulating
Airdesign, Inc.
Allied Radio Corp.
Allis-Chalmers
American Transformer
Amplifier Co.
Chicago Transformer
Cole Instrument
Davis & Co., Inc., Dean
General Elec. Co.
Heri Duty Electric
Miller Transformer
Sola Electric Co.
Sorensen & Co.
Standard Transformer
Superior Electric
Thordarson Elec. Mfg.
United Transformer Corp.

TRANSITS, Engineer's (See Surveying Instruments)

TRANSITS, Pocket
Ainsworth & Sons
Keuffel & Esser Co.
Mico Instrument Co.
Sweerkrop Instruments
United States Blue Print
Warren Knight Co.
White Co., Inc.

TRUCK MILEAGE RECORDERS (See Meters, Mileage)

TRUCK-TIME RECORDERS
Service Recorder Co.
U. S. Taximeter

TRUCK, TIME & MILEAGE RECORDERS
Cramer & Co., Inc.
Sangamo Electric Co.
U. S. Taximeter

TURE FITTINGS
Parker Appliance Co.

TURES (See Gas & Vapor Discharge Tubes)

TUBES, Cathode Ray (See Oscillographs, Cathode Ray)

TUBES, Nessler (See Nessler Tubes)

TUBES, Oil Centrifuge (See Oil Centrifuge Tubes)

TUBES, Photoelectric
Continental Electric Co.
General Elec. Co.
General Scientific Co.
Instrument Dev. Labs.
Mellaphone Corp.
RCA Div.
Vacutron, Inc.
Walker-Jimieson, Inc.

TUBES, Pitot (See Flowmeters, Pitot Tube)

TUBES, Polariscope
American Inst. Co.
Bausch & Lomb Optical
Central Scientific Co.
Fecker, J. W.
Gaertner Scientific Corp.
Hellige, Inc.
Jarrell-Ash Co.
Koehler Instrument
Precision Scientific Co.
Rudolph & Sons
Sargent & Co.

TUBES, Precision Bore (See Precision Bore Glass Tubing)

TUBES, Pyrometer
Bristol Co.
Brown Instrument Div.
Campbell Co., J. A.
Eitzen Co.
Elematic Equip. Corp.
Englehard, Chas.
Fish-Schurman Corp.
Foxboro Co.
Gordon Co., Claud S.
Illinois Testing Labs.
Leeds & Northrup Co.
Moeller Instrument Co.
Morganite, Inc.
Pyrometer Service Co.
Revere Corp.
Richards, Arklay S.
Taco West Corp.
Tagliabue Corp., C. J.
Taylor Instrument Cos.
Thermo-Electric Co.
Thwing-Albert Inst. Co.
Trinity Equipment
Turner Electric Co.
Wheatstone Corp.
Wheelco Instruments

TUBES, Spectrum (See Spectrum Tubes)

TUBES, Ultra-Violet Light (See Light Sources)

TUBES, Vacuum
Ballantine Labs.
Central Scientific Co.
Continental Corp.
Eclipse-Pioneer
Electronic Products Co.
Electrons, Inc.
Federal Telephone
Frederick Co., George
General Elec. Co.
General Scientific Corp.
Machlett Labs.
North Amer. Philips
Passaic Analytical Labs.
Raytheon Mfg. Co.
RCA Div.
Standard Arcturus
Sorensen & Co.
Sylvania Elec. Prod.
United Electronics
Universal X-Ray Products
Vacutron Inc.
Victoreen Instrument
Walker-Jimieson, Inc.
Western Electric
Wheelco Inst. Co.

TUBES, Venturi (See Flowmeters, Venturi)

TUBES, X-Ray
American Inst. Co.
Baird Associates
Corning Glass Works
Eureka X-Ray Tube
Flett Lab.
General Electric X-Ray
Goetze Niemer Co.
High Voltage Eng.
Jarrell-Ash Co.
Kelley Koett Mfg.
Machlett Labs.
North Amer. Philips
Picker X-Ray
Standard Arcturus
Stoelting Co., C. H.
Universal X-Ray Prods.
Westinghouse Elec.
Westinghouse X-Ray Co.
Wyland George

TUPING: Precision Bore; Bourdon; Pointers
Precision Tube
Superior Tube

TUNING FORKS, Electrically Driven (See Forks, Tuning)

TURRIDIMETERS
American Inst. Co.
Bowen & Co.
Cargille, R. P.
Central Scientific Co.
Electric Eye Equipment
Ese Instrument Co.
Ferguson Co.
Fisher Scientific Co.
Hellige, Inc.
Klett Mfg. Co.
Kimble Glass Co.
Parr Instrument Co.
Pfaltz & Bauer, Inc.
Photoswitch, Inc.
Photovolt Corp.
Precision Scientific Co.
Rawson Electrical Inst.
Rubicon Co.
Sensitive Research Inst.
Zeiss, Inc., Carl

TURN & BANK INDICATORS
Doeleam Corp.
Eclipse-Pioneer Div.
Kollsman Inst. Co.
Summers Gyroscope

TURN INDICATOR TESTERS (See Testers, Turn Indicator

TWEEZERS
Bayside Watch Tool
Goetze Niemer Co.
Ideal Laboratory Tool
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TWIST COUNTERS (See Counters, Twist)

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National Tech. Labs.
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ULTRA-VIOLET LIGHT SOURCES (See Light Sources)

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(.010" to 5/8" O.D. Max.)

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AISI—303, 304, 309, 310, 316, 317, 321, 347, 403, 420, 430, 446, 502 (T-1)
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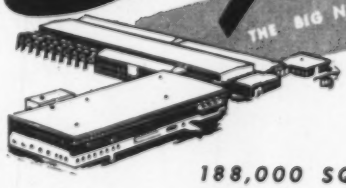

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VALVES, Pressure Relief, Hoke, Inc.

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½" to .010" O.D. any wall thickness

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Walls to .0010"

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A seamless metal Shield over any type Electric Conductor.

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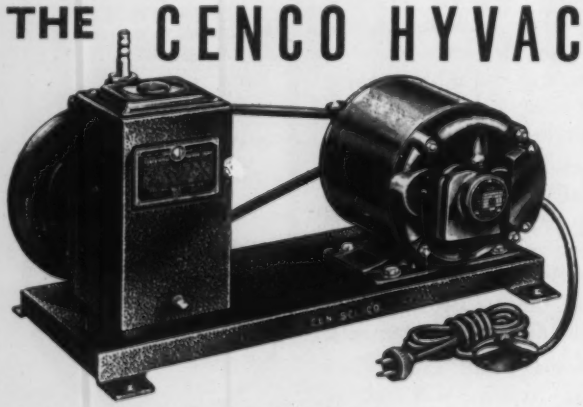

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U-TUBE MANOMETERS (See Manometers)

VACUUM GAGES, Discharge
Distillation Products
Manning, Maxwell, Moore
National Research
RCA Div.
Universal X-Ray Prods.
Skaneateles Mfg.

VACUUM GAGES, Hot-Wire
Baird Associates
Continental Elec. Co.
Distillation Products
Flett Lab.
Fredericks Co., Geo.
General Elec. Co.
General Physical Lab.
Hastings Instruments
National Research
Process & Instruments
Universal X-Ray Prods.
Winslow Co.

VACUUM GAGES, Ionization
Ballantine Labs.
Central Scientific Co.
Distillation Products
Fredericks Co., Geo.
General Elec. Co.
National Research
Nuclear Inst. & Chem.
Precision Scientific
Process & Instruments
RCA Div.
Stoelting Co., C. H.
Sylvania Electric Prod.
Universal X-Ray Prods.
Welch Scientific
Winslow Co.

VACUUM GAGES, Liquid-column
American Meter Co.
Bacharach Industrial Inst.
Bailey Meter Co.
Defender Automatic Reg.
Distillation Products
Dwyer Mfg. Co.
Ferguson Co.
Foxboro Co.
Gas Appliance Specialties
Ideal Lab. Tool
Jerguson Gage & Valve
Kontes Glass Co.
Meriam Instrument
Moeller Inst. Co.
Parks Co., Harry S.
Phoenix Prec. Inst.
Pioneer Instrument
Precision Thermometer
Scientific Glass Apparatus
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Trerice Co.
Uehling Instrument Co.
Universal X-Ray Prods.
Wallace & Tiernan
Welch Scientific

VACUUM GAGES, McLeod
Ace Glass, Inc.
Central Scientific Co.
Distillation Products
Electronic Products Co.
Ferguson Co.
General Elec. Co.
General Physical Lab.
Hays Corp.
Kontes Glass Co.
Macalaster Bicknell Co.
Phoenix Prec. Inst.
Scientific Glass Apparatus
Stoelting Co., C. H.
Stokes Machine Co.
Universal X-Ray Prods.
Welch Scientific

VACUUM GAGES, Pirani Type
Ballantine Labs.
Continental Electric
Distillation Products
Ferguson Co.
Fredericks Co., George
General Elec. Co.
Macalaster Bicknell
Sylvania Elec. Prod.
General Physical Lab
Process & Instruments
Universal X-Ray Prods.
Welch Scientific
Winslow Co.

VACUUM GAGES, Thermocouple
Distillation Products
Fredericks Co., George
General Electric Co.
Hastings Instruments
National Research
RCA Div.
Sylvania Elec. Prod.
Universal X-Ray Prods.
Welch Scientific
Winslow Co.

VACUUM Indicators
American Meter Co.
Ashton Valve Co.
Bailey Meter Co.
Baird Associates
Bristol Co.
Brown Instrument Div.
Central Scientific Co.
Distillation Products
Foxboro Co.
Fredericks Co., George
General Elec. Co.
General Physical Lab.
Gotham Inst. Co.
Hastings Instruments
Hays Corp.
Kollsman Inst.
Manning, Maxwell & Moore
Marsh Corp.
Mason-Neilan Regulator
(Continued)
Meriam Instrument
Moeller Instrument Co.
National Research
Potter Co.
Precision Scientific
Precision Therm.
Process & Instruments
Rawson Electrical Inst.
Republic Flow Meters
Rochester Mfg. Co.
Schauer Mach. Co.
Scientific Glass App.
Skaneateles Mfg.
Star Brass Mfg. Co.
Statham Labs.
Stoelting Co., C. H.
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Trerice Co.
Uehling Instrument Co.
U. S. Gauge
Universal X-Ray Prods.
Wallace & Tiernan
Weksler Thermometer

VACUUM, HIGH (below 1 mu) Controllers, Indicators & Recorders
Baird Associates
Continental Elec. Co.
Distillation Products
Electronic Prod. Co.
Fredericks Co., Geo.
General Elec. Co.
General Physical Lab.
Manning, Maxwell, Moore
National Research
Process & Instruments
Shallcross Controls
Stoelting Co., C. H.
Taylor Instrument Cos.
Universal X-Ray Prods.
Weksler Thermometer
Welch Mfg. Co.

VACUUM, HIGH (below 500 mu) Controllers, Indicators, Recorders
Distillation Products
General Physical Lab.
Manning, Maxwell, Moore
Process & Instruments
Skaneateles Mfg.
Universal X-Ray Products
Winslow Co., Inc.

VACUUM RECORDERS
American Meter Co.
Ashton Valve Co.
Bailey Meter Co.
Bristol Co.
Brown Inst. Div.
Defender Inst. & Reg.
Dickson Co.
Distillation Products
Esterline Angus Co.
Fish-Schurman Corp.
Foxboro Co.
Fredericks Co., George
Gotham Inst. Co.
Hays Corp.
Manning, Maxwell, Moore
Marsh Corp.
Mason-Neilan Regulator
National Research
Penn Ind. Inst. Corp.
Precision Scientific
Republic Flow Meters
Schwien Engineering
Scientific Instrument Co.
Skaneateles Mfg.
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Trerice Co.
Uehling Instrument Co.
Weksler Thermometer

VACUUM SPECTROGRAPHS (See Spectrographs, Vacuum)

VACUUM TUBES (See Tubes, Vacuum)

VACUUM TUBE BRIDGES (See Bridges Electrical, Vacuum Tube)

VACUUM TUBE RELAYS (See Relays, Vacuum Tube)

VACUUM TUBE VOLTMETERS (See Voltmeters, Vacuum Tube)

VALVE BOX FINDER (See Finder, Valve Box)

VALVE-OPERATING DEVICES, Electric Motor
Allis-Chalmers
Automatic Temp. Control
Baldwin Locmotive
Barber-Colman Co.
Beck Co.
Bristol Co.
Brooke Engineering
Brown Instrument Div.
Clark Cooper Co.
Cleveland Fuel Equip.
Climax Engineering
Continental Equip. Co.
Cramer & Co., Inc.
Cutler-Hammer, Inc.
Dickson Co.
Eclipse-Pioneer Div.
Foxboro Co.
General Controls Co.
General Electric Co.
General Regulator Corp.
Hays Corp.
Jenkins Bros.
Keckley Mfg. Co.
Lear, Inc.
Leeds & Northrup
Lumenite Electronic
McAlear Mfg. Co.
Philadelphia Gear Works
Robinette Co., W. C.
R-S Products
Ruggles-Klingemann
Shallcross Controls
Tagliabue Corp., C. J.
Wilson & Co.

VALVE OPERATING DEVICES, Electric Solenoid (See Valves, Solenoid)

VALVE OPERATING DEVICES, Hydraulic (See Valves, Hydraulically Operated)

VALVE-OPERATING DEVICES, Pneumatic (See Valves, Diaphragm)

VALVE POSITION INDICATORS
Allis-Chalmers
Autocall Co.
Automatic Temp. Control
Bailey Meter Co.
Barber Coleman
Beck Co.
Bendix Marine Products
Bristol Co.
Builders-Providence
Conoflow Corp.
Cutler-Hammer, Inc.
Elec. Indicator Corp.
Elec. Tachometer Corp.
Fischer & Porter
Fisher Governor
Foxboro Co.
General Controls
General Electric Co.
General Regulator Corp.
Hammel-Dahl Co.
Kiely & Mueller
Lear, Inc.
Leupold & Stevens
Manning, Maxwell & Moore
Moore Products
Northern Equip. Co.
Republic Flow Meters
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Tejax Eng. Corp.
Westinghouse Elec. & Mfg.
Wheelco Instrument

VALVE POSITIONERS
Bristol Co.
Brown Inst. Div.
Foxboro Co.
Mason-Neilan Reg. Co.
Moore Products Co.
Penn Ind. Inst. Corp.
Taylor Inst. Cos.

VALVES, Automatic Shut-off
Adel Precision Prods.
Annin Co.
Askania Regulator Co.
Atlas Valve Co.
Automatic Switch Co.
Automatic Temp. Control
Automatic Valve Control
Barber-Colman
Bastian-Blessing
Belfield Div.
Brown Instrument Div.
Cash Co.
Clark Cooper Co.
Climax Engineering
Continental Equip. Co.
Davis Reg. Co.
Edison, Instrument Div.
Farris Engineering
Fisher Governor
Foster Engg. Co.
Frick Co.
Friez Instrument
General Controls Co.
Grove Regulator
Hammel-Dahl Co.
Jerguson Gage Co.
Kiely & Mueller
Leslie Co.
Manning, Maxwell & Moore
Mason-Neilan Regulator
McAlear Mfg.
Milwaukee Gas Spec.
Minneapolis-Honeywell
North Amer. Mfg. Co.
OPW Corp.
Parlow Corp.
Paul Valve Co.
Preferred Utilities
R-S Prod. Corp.
Ruggles-Klingemann
Schade Valve Mfg. Co.
Seely Inst. Co., Inc.
Sinclair-Collins Valve
Skaneateles Mfg. Co.
Smith Meter
Tagliabue Corp., C. J.
Valvair Corp.
Vapor Recovery Systems
Wheelco Instruments

VALVES, Automatic Solenoid (See Valves, Solenoid)

VALVES, Balanced
Acme Scientific
American Meter Co.
Atlas Valve Co.
Bailey Meter Co.
Baldwin Locomotive
Barber Colman
Belfield Div.
Boylston Co.
Bristol Co.
Cash Co.
Clark Cooper Co.
Climax Engineering
Conoflow Corp.
Davis Reg. Co.
Defender Inst. & Reg.
Dennison Engineering
Fischer & Porter
Fisher Governor Co.
Ford Reg. Valve Co.
Foster Engg. Co.
Foxboro Co.
General Controls Co.
Hammel-Dahl Co.
Jenkins Bros.
Keckley Mfg. Co.
Kiely & Mueller
Klingerit, Inc.
Klinfel Mfg. Co.
Leslie Co.
Mason-Neilan Regulator
(Continued)

McAlear Mfg.
Minneapolis-Honeywell
Natural Gas Equipment
North Amer. Mfg. Co.
Northern Equip. Co.
NuPW Corp.
Powers Regulator Co.
Republic Flow Meters
Reynolds Gas Regulator
Ruggles-Klingemann
Schade Valve Mfg. Co.
Seely Inst. Co., Inc.
Sinclair Collins Valve
Spence Engineering Co.
Swartwout Co.
Tagliabue Corp., C. J.
Trerice Co.
Valvair Corp.
Watts Regulator Co.
Wood, Harry W.

VALVES, Constant Pressure
Atlas Valve
Bailey Meter Co.
Bastian-Blessing Co.
Belfield Div.
Brooke Engineering
Climax Engineering
Cash Co.
Clark Cooper Co.
Davis Reg. Co.
Dennison Engineering
Fisher Governor Co.
Foster Engg. Co.
General Controls
Grove Regulator
Hammel-Dahl Co.
Henry Valve Co.
Hoke, Inc.
Jenkins Bros.
Keckley Mfg. Co.
Kiely & Mueller
Klipfel Mfg. Co.
Leslie Co.
Manning, Maxwell & Moore
Mason-Neilan Regulator
McAlear Mfg.
Mercon Regulator
Northern Equipment
Powers Regulator Co.
Reynolds Gas Regulator
R-S Prod. Corp.
Ruggles-Flingemann
Schade Valve Mfg. Co.
Seely Inst. Co.
Sinclair-Collins Valve
Spence Engineering Co.
Swartwout Co.
Tagliabue Corp., C. J.
Taylor Inst. Co.
Vapor Recovery Systems
Vaughn-G. E. Witt Co.
Watts Regulator Co.

VALVES, Diaphragm
Adel Precision Products
Annin Co.
Askania Regulator Co.
Atlas Valve Co.
Automatic Temp. Control
Bailey Meter Co.
Baldwin Locomotive
Bastian-Blessing Co.
Belfield Div.
Boylston Co.
Bristol Co.
Brown Instrument Div.
Cash Co.
Climax Engineering
Conoflow Corp.
Continental Equip. Co.
Cook Electric
Davis Reg. Co.
Defender Inst. & Reg.
Eclipse-Pioneer Div.
Emmett Machine
Farris Engineering
Fischer & Porter
Fisher Governor
Foster Engg. Co.
Foxboro Co.
General Controls Co.
Gotham Inst. Co.
Hagan Corp.
Hammel-Dahl Co.
Henry Valve Co.
Hoke, Inc.
Industrial Filter
Johnson Service Co.
Keckley Mfg. Co.
Kiely & Mueller
Klipfel Mfg. Co.
Laboratory Equipment
Leslie Co.
Manning, Maxwell & Moore
Mason-Neilan Regulator
McAlear Mfg.
Mead Specialties Co.
Minneapolis-Honeywell
National Airoil Burner
Natural Gas Equipment
North Amer. Mfg. Co.
Partlow Corp.
Paul Valve Co.
Payne Furnace & Supply
Powers Regulator Co.
Refrigerating Spec. Co.
Republic Flow Meters
Reynolds Gas Regulator
Rockwell Mfg.
R-S Products Corp.
Ruggles-Klingemann
Schade Valve Mfg. Co.
Scientific Instrument Co.
Seely Inst. Co., Inc.
Sinclair Collins Valve
Spence Engineering Co.
Swartwout Co.
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Trerice Co.
Valvair Corp.
Vaughn-G. E. Witt
Watts Regulator
White-Rodgers Electric

VALVES, Electrically Operated
Adel Precision Prods.
Atlas Valve Co.
Automatic Products Co.
Automatic Switch Co.
Automatic Temp. Control
Baldwin Locomotive
Barber-Colman
Beck Co.
Bristol Co.
Brooke Engineering
Brown Instrument Div.
Clark Cooper Co.
Cutler-Hammer, Inc.
Davis Reg. Co.
Defender Inst. & Reg.
Dennison Engineering
Distillation Products
Electric Valve Mfg.
Electrimatic Corp.
Foster Engg. Co.
Foxboro Co.
Frick Co.
Friez Instrument
General Controls Co.
General Electric Co.
Henry Valve Co.
Jenkins Bros.
Keckley Mfg. Co.
Kiely & Mueller
Klipfel Mfg. Co.
Lear, Inc.
Leslie Co.
Magnatrol Valve Corp.
Manning, Maxwell & Moore
Mason-Neilan Regulator
Minneapolis-Honeywell
North Amer. Mfg. Co.
Northern Equipment Co.
Paul Valve Co.
Payne Furnace & Supply
Penn Electric Switch
Perfex Corp.
Philadelphia Gear Works
Preferred Utilities
R-S Prod. Corp.
Ruggles-Klingemann
Schade Valve Mfg. Co.
Seely Inst. Co., Inc.
Shallcross Controls
Shallcross Mfg. Co.
Sinclair-Collins Valve
Spence Engineering Co.
Supreme Elec. Prods.
Tagliabue Corp., C. J.
Valvair Corp.
Wheelco Instruments
White-Rodgers Elec. Co.
Yellow Springs Inst. Co.

VALVES, Hydraulically Operated
Acme Industrial
Adel Precision
Annin Co.
Arca Regulators, Inc.
Askania Regulator
Atlas Valve Co.
Auto. Temp. Control
Bailey Meter
Baldwin Locomotive
Barber Colman Co.
Belfield Div.
Cash Co.
Clark Cooper Co.
Conoflow Corp.
Continental Equip. Co.
Controls, Inc.
Defender Inst. & Reg.
Dennison Engineering
Eclipse-Pioneer Div.
Farris Engineering
Fisher Governor
Ford Reg. Valve
Foster Engg. Co.
General Controls
General Electric Co.
General Regulator Corp.
Hagan Corp.
Hammel-Dahl Co.
Hays Corp.
Hydraulic Controls, Inc.
Jenkins Bros.
Johnson Service Co.
Keckley Mfg. Co.
Kiely & Mueller
Leslie Co.
Leupold & Stevens
Mason-Neilan Regulator
McAlear Mfg. Div.
North Amer. Mfg. Co.
Paul Valve Co.
Perfex Corp.
Philadelphia Gear Works
Positel Mfg. Co.
Powers Regulator Co.
Republic Flow Meter
Rockwell Mfg.
R-S Prod. Corp.
Ruggles-Klingemann
Schade Valve Mfg. Co.
Seely Inst. Co.
Shallcross Controls
Sinclair-Collins Valve
Shand & Jurs Co.
Spence Engineering
Sterling Eng. Co.
Sundstrand Machine Tool
Valvair Corp.
Vinco Corp.
Waterman Eng. Co.
Wilgus Mfg. Co.

VALVES, Lubricated Plug
Acme Industrial
Belfield Div.
Clark Cooper Co.
Industrial Filter
Parker Appliance
Rockwell Mfg.

VALVES, Motor Operated **(See Valves, Diaphragm; Valves, Electrically-operated; Valves, Hydraulically-operated; Valves, Solenoid)**

VALVES, Pressure Relief, Reducing, etc.
Acme Industrial
Adel Precision Prods.
American Dist. Steam
American Meter Co.
Ashton Valve Co.
Askania Regulator Co.
Atlas Valve Co.
Autoclave Engineers
Bailey Meter Co.
Bastian-Blessing Co.
Belfield Div.
Bristol Co.
Brown Instrument Div.
Brown & Sharpe
Cash Co.
Clark Cooper Co.
Climax Engineering
Conoflow Corp.
Crosby Steam Gage Co.
Davis Reg. Co.
Eclipse-Pioneer Div.
Farris Engineering
Fisher Governor Co.
Ford Reg. Valve
Foster Engg. Co.
Foxboro Co.
Frick Co.
Fulton-Sylphon
General Controls
Gotham Inst. Co.
Grove Regulator
Hagan Corp.
Hammel-Dahl Co.
Henry Valve Co.
Hoke, Inc.
Instrument Repair & Mfg.
Johnston & Jennings Co.
Keckley Mfg. Co.
Kenyon Instrument Co.
Kiely & Mueller
Klipfel Mfg. Co.
Lammert & Mann Co.
Lear, Inc.
Leslie Co.
Lonergan Co.
Manning, Maxwell & Moore
Marsh Corp., Jas. P.
Mason-Neilan Regulator
McAlear Mfg.
Mead Specialties
Mercon Regulator
Minneapolis-Honeywell
Natural Gas Equipment
Northern Equipment
Parker Appliance
Powers Regulator Co.
Preferred Utilities
Republic Flow Meters
R-S Products Corp.
Ruggles-Klingemann
Ruska Inst. Corp.
Saval Co.
Schade Valve Mfg. Co.
Seely Inst. Co., Inc.
Shand & Jurs Co.
Spence Engineering Co.
Swartwout Co.
Tagliabue Corp., C. J.
Taylor Instr. Cos.
Trerice Co.
Vapor Recovery Systems
Vaugh-G. E. Witt Co.
Victor Equipment Co.
Watts Regulator Co.

VALVES, Proportional Air-Gas
American Meter Co.
Askania Regulator Co.
Automatic Temp. Control
Barber-Colman
Bristol Co.
Brown Instrument Div.
Cash Co.
Cutler-Hammer, Inc.
Fisher Governor Co.
General Controls
Hagan Corp.
Hammel-Dahl Co.
Keckley Mfg. Co.
Lammert & Mann Co.
Mason-Neilan Regulator
North American Mfg.
Parker Appliance Co.
R-S Prod. Corp.
Tagliabue Corp., C. J.
Trerice Co.

VALVES, Regulating
Am. Gas Furnace Co.
American Meter Co.
Arca Regulators, Inc.
Askania Regulator Co.
Atlas Valve Co.
Autoclave Engineers
Automatic Temp. Control
Bailey Meter Co.
Barber Colman
Bastian-Blessing Co.
Belfield Div.
Boylston Co.
Bristol Co.
Brooke Engineering
Brown Instrument Div.
Cash Co.
Clarke Cooper Co.
Climax Engineering
Conoflow Corp.
Cook Electric
Davis Reg. Co.
Defender Inst. & Reg.
Electronic Corp.
Erickson Specialty
Fischer & Porter
Fisher Governor Co.
Ford Reg. Valve Co.
Foster Engg. Co.
Foxboro Co.
Friez Instrument Div.
Fulton Sylphon Div.
General Controls Co.
Grove Regulator
Hagan Corp.
Hammel-Dahl Co.
Hannifin Mfg. Co.

(Continued)

Hoke, Inc.
Jenkins Bros.
Keckley Mfg. Co.
Kiely & Mueller
Klipfel Mfg. Co.
Lammert & Mann Co.
Leslie Co.
Manning, Maxwell & Moore
Mason-Neilan Regulator
McAlear Mfg. Div.
Mead Specialties Co.
Mercon Regulator
Minneapolis-Honeywell
National Airoil Burner
Natural Gas Equipment
North Amer. Mfg. Co.
Northern Equipment Co.
Partlow Co.
Parr Inst. Co.
Powers Regulator Co.
Preferred Utilities
Republic Flow Meters
Robertshaw Thermostat
R-S Prod. Corp.
Ruggles-Klingemann
Ruska Inst. Corp.
Schade Valve Mfg. Co.
Seely Inst. Co., Inc.
Shallcross Controls
Spence Engineering Co.
Swartwout Co.
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Trerice Co.
Vapor Recovery Systems
Vaughn G. E. Witt
Waterman Engineering
Watts Regulator Co.
Wheelco Instruments

VALVES, Safety Fuel Shutoff
American Meter Co.
Askania Regulator Co.
Atlas Valve Co.
Automatic Products Co.
Automatic Switch Co.
Bastian-Blessing
Belfield Co.
Bristol Co.
Brown Instrument Div.
Cash Co.
Clark Cooper Co.
Climax Engineering
Continental Equip. Co.
Davis Reg. Co.
Eclipse Fuel Engg. Co.
Farris Engineering
Fisher Governor
Friez Instrument Div.
Fulton Sylphon Div.
General Combustion Corp.
General Controls Co.
Grove Regulator
Hammell-Dahl Co.
Henry Valve Co.
Keckley Mfg. Co.
Kiely & Mueller
Leslie Co.

(Continued)

REPUBLIC REGULATING VALVES

All Republic valves are engineered to the specific job on which they are used. Cylinder operated valves are available in sizes from 3 in. to 24 in. Hand operated valves in sizes from 1 in. to 8 in. Lever operated valves in sizes up to 16 inch.

Republic valves are built in all pressure standards — both flanged and welded ends. Streamlined flow through parts virtually eliminates erosion.

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NEW CATALOG AND DATA BOOK ON SAFETY and RELIEF VALVES
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Comparison, Selection and Sizing Charts
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All the information needed for installation and operation of Safety or Relief Valves

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Company.....
Street.....
City.....Zone....State.....
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Manufacturers of Safety, Relief & Pinch Valves

VOLTMETERS, A-c. Ree- Sticht Co.

Laboratory Standards

PEAK-TO-PEAK VOLTMETER
MODEL 67

VOLTAGE RANGE: .0005-300 volts peak-to-peak; .0002-100 volts r.m.s.
FREQUENCY: 5-100,000 sine-wave cycles per second.
INPUT IMPEDANCE: 1 megohm shunted by 30 mmfd.
POWER SUPPLY: 117 volts, 50-60 cycles.
DIMENSIONS: Width 7", height 7½", depth 8½".
WEIGHT: 8 lbs.

MEASUREMENTS CORPORATION BOONTON NEW JERSEY

Lonergan Co.
Manning, Maxwell & Moore
Mason-Neilan Regulator
Milwaukee Gas Specialty
Minneapolis-Honeywell
National Airoil Burner
Natural Gas Equipment
North Amer. Mfg. Co.
OPW Corp.
Partlow Corp.
Payne Furnace & Supply
Penn Electric Switch
Preferred Utilities Mfg.
R-S Products
Ruggles-Klingemann
Saval Co.
Schade Valve Mfg. Co.
Seely Inst. Co., Inc.
Spence Engineering Co.
Tagliabue Corp., C. J.
Vapor Recovery Systems
Viking Instrument Co.
Wheelco Instruments

VALVES, Solenoid
Adel Precision Prods.
Annin Co.
Atlas Valve Co.
Automatic Products Co.
Automatic Switch Co.
Automatic Temp. Control
Baldwin Locomotive
Barber-Colman Co.
Brown Instrument Div.
Clark Cooper Co.
Continental Equip. Co.
Cook Electric
Cutler-Hammer, Inc.
Davis Reg. Co.
Dennison Engineering
Distillation Products
Electrimatic Corp.
Emmett Machine
(Continued)

Erickson Specialty
Foxboro Co.
Frick Co.
Friez Instrument Div.
General Controls Co.
General Electric Co.
Gleason-Avery, Inc.
Gordon Co., Claud S.
Grove Regulator
Guardian Elec. Mfg.
Hannifin Mfg. Co.
Hays Corp.
Henry Valve Co.
Instrument Dev. Labs.
Kiely & Mueller
Leslie Co.
Magnatrol Valve Corp.
Minneapolis-Honeywell
Northern Equip. Co.
Partlow Corp.
Paul Valve Co.
Perfex Corp.
Preferred Utilities
R-S Prod. Corp.
Ruggles-Klingemann
Sampsel Time Control
Saval Co.
Schade Valve Mfg. Co.
Seely Inst. Co., Inc.
Shallcross Controls
Sinclair Collins Valve
Skaneateles Mfg. Co.
Spencer Engineering Co.
Sterling Eng. Co.
Sundstrand Machine Tool
Tagliabue Corp., C. J.
Taylor Inst. Cos.
Valvair Corp.
Wheelco Instruments
White Rodgers Elec.
Yellow Springs Instrument

VALVES, Thermostat (See Thermostats)

VAR METERS (See Volt-ampere Meters, Reactive)

VEHICLE TRAVEL RECORDERS
Commercial Research
Cramer & Co.
Elec. Tachometer Corp.
Knopf Instrument
Service Recorder Co.
Speedometer Electric
U. S. Taximeter

VENTURI METERS (See Flowmeters, Venturi)

VENTURI TUBES (See Flowmeters, Venturi)

VIBRATION PICKUPS
Amperite Co.
Baldwin Locomotive
Brush Development
Calidyne Co.
Commercial Research
Consolidated Engg.
Crystal Research Labs.
Electro Prod. Labs.
Engineering Res. & Dev.
Flader Inc., Fredric
General Radio Co.
Geophysical Inst. Co.
Hathaway Inst. Co.
Heiland Research
Massa Laboratories
M B Mfg. Co.
Schaevitz Engineering
Scott Inc., Hermon
Sperry Gyroscope Co.
Statham Labs.
Van Dyke Instruments
Western Electric
Westinghouse Elec.

VIBOGRAPHS
Baldwin Locomotive
Cambridge Inst. Co.
Central Scientific Co.
Chicago Apparatus Co.
Commercial Research
Heiland Research
Impact Register Co.
RCA Div.
Ruska & Co.
Westinghouse Elec.

VIBROMETERS
Aircraft Electronics
American Inst. Co.
Associated Research
Ballantine Labs.
Consolidated Engg.
Electrocon Corp.
General Radio Co.
Hathaway Instrument
Heiland Research
Martin-Hubbard Corp.
Massa Laboratories
Potter Co.
Sticht Co.
Van Dyke Instruments
Western Electric
Westinghouse Elec.

VIBROSCOPES
Aircraft Electronics
Amperite Corp.
Brush Development
Century Geophysical
Coleman Instrument
Commercial Engg. Labs.
General Elec. Co.
Heiland Research Corp.
Humboldt Mfg. Co.
Massa Laboratories
Varo Mfg. Co.

VICAT NEEDLES (See Needles Vicat)

VISCOSIMETER BATHS, Constant-temperature
Aloe Co., A. S.
American Inst. Co.
Brabender Corp.
Braun Corp.
Central Scientific Co.
Coleman Inst. & Reg.
Eitzen Co.
Electric Heat Control
Electric Hotpack Co.
Fish-Schurman Corp.
Fisher Scientific Co.
Humboldt Mfg. Co.
Koehler Instrument
Modern Electrical Lab.
Precision Scientific Co.
Process & Instruments
Ruska Instrument
Sargent & Co., E. H.
Scientific Glass App.
Tagliabue Corp., C. J.
Thomas Co., Arthur H.
Thwing-Albert

VISCOSIMETER, Brookfield
Brookfield Eng. Labs.

VISCOSIMETERS, Engler
American Inst. Co.
Boekel & Co.
Central Scientific Co.
Hiergesell & Sons
Humboldt Mfg. Co.
Kimble Glass
Precision Scientific Co.
Ruehfel Co.

VISCOSIMETERS, Fenske
American Inst. Co.
Fisher Scientific Co.
Humboldt Mfg. Co.
Kimble Glass
Phoenix Prec. Inst.
Precision Scientific
Tagliabue Corp., C. J.

VISCOSIMETERS, Ford (For Paint)
Central Scientific Co.
Humboldt Mfg. Co.
Koehler Instrument Co.
Scientific Inst. Co.

VISCOSIMETERS, Hoeppler
Central Scientific Co.
Fish-Schurman Co.
Phoenix Prec. Inst.
Precision Scientific
Sargent & Co.

VISCOSIMETERS, Kinematic
American Inst. Co.
Braun Corp.
Fischer & Porter
Fisher Scientific Co.
Hiergesell & Sons
Koehler Instrument
Precision Scientific Co.
Tagliabue Corp., C. J.

VISCOSIMETERS, MacMichael
Fisher Scientific Co.

VISCOSIMETERS, Recording
Brabender Corp.
Brookfield Engg. Labs.
Coleman Inst. & Mfg.
Doelcam Corp.
Esterline-Angus Co.
Fischer & Porter
Hayes Scientific App.
Norcross Corp.
Precision Scientific

VISCOSIMETERS, Redwood
American Inst. Co.
Hiergesell & Sons
Ruehfel Co.

VISCOSIMETERS, Saybolt
American Inst. Co.
Boekel & Co.
Central Scientific Co.
Corning Glass Works
Eitzen Co.
Hiergesell & Sons
Humboldt Mfg. Co.
Kimble Glass Co.
Monarch Mfg. Wks.
Precision Scientific Co.
Ruehfel Co.
Tagliabue Corp., C. J.
Zuhr, Inc., Henry

VISCOMETERS, Scott
Boekel & Co.
Central Scientific Co.
Hiergesell & Sons
Precision Scientific Co.
Ruehfel Co.
Sargent & Co.
Scott Testers

VISCOSIMETERS, Stormer
Aloe Co., A. S.
Central Scientific Co.
Hiergesell & ons
Industro-Scientific Co.
Thomas Co., Arthur H.

VISCOSIMETERS, Ubbelhode
American Inst. Co.
Boekel & Co.
Central Scientific Co.
Fish-Schurman Co.
Hiergesell & Sons
Precision cientific Co.
Sargent & Co.
Tagliabue Corp., C. J.

VISCOSIMETERS, Zahn
General Elec. Co.
Precision Scientific

VISCOSITY REGULATORS (See Controllers, Automatic, Viscosity

VISCOSITY TUBES
Cargille, R. P.
Eitzen Co.
Fischer & Porter
Gardner Laboratory
Fish-Schurman Co.
Humboldt Mfg. Co.
Koehler Instrument
Phoenix Prec. Inst.
Precision Scientific

VOLTAGE ADJUSTERS, AUTOMATIC
Amplifier Co.
General Elec. Co.
Ideal Commutator Dresser
Lewis Co., J. B.
Sherron Metallic
Sola Electric Co.
Sorensen & Co.
Weltronic Co.

VOLTAGE DETECTORS (See Detectors, Voltage)

VOLTAGE DIVIDERS, Radio Frequency (See Dividers, Voltage)

VOLTAGE, HIGH (above 2300 volts) Indicators
Ballantine Labs.
Bradshaw Instruments
Cole Instrument
Dale Instruments
General Elec. Co.
General Physical Lab.
Ideal Commutator Dresser
Leeds & Northrup Co.
Meters, Inc.
Precision Apparatus
Rawson Electrical Inst.
Roller-Smith
Sensitive Research Inst.
Shallcross Mfg. Co.
Sherron Metallic
Triplett Electrical Inst.
Westinghouse Elec.
Weston Elec. Inst. Corp.

VOLTAGE, HIGH (above 2300 volts) Measuring Devices
Associated Research
Ballantine Labs.
Barber Labs., Alfred
Bradshaw Instruments
(Continued)

Cole Instrument
Ferranti Electric
Freed Transformer
General Elec. Co.
International Resistance
Leeds & Northrup
Meters, Inc.
Precision Apparatus
Radio City Products
Rawson Elec. Inst. Co.
Reiner Electronics
Roller-Smith
Rowe Engineering
Sensitive Research Inst.
Shallcross Mfg.
Triplett Elec. Inst.
Sherron Metallic
Shallcross Mfg.
Westinghouse Elec.
Westinghouse X-Ray Co.
Weston Elec. Inst. Corp.

VOLTAGE, HIGH (above 2300 volts) Testing Devices
American Transformer
Associated Research
Bradshaw Instruments
Cole Instrument
General Elec. Co.
Industrial Insts., Inc.
International Resistance
MacLeod & Hanpol
Miller Co., Bertrand F.
Precision Apparatus
Radio City Products
Raytheon Mfg. Co.
Reiner Electronics
Roller-Smith Co.
Rowe Engineering
S & C Electric
Sensitive Research Inst.
Shallcross Mfg. Co.
Sherron Metallic
States Co.
Superior Elec. Co.
Thordarson Elec. Mfg.
Triplett Elec. Inst.
Westinghouse Elec.
Weston Elec. Inst. Corp.

VOLTAGE REGULATORS (See Regulators, Automatic, Voltage)

VOLT-AMMETERS
Am. Elec. Sales Co.
Assembly Products
Associated Research, Inc.
Bradshaw Instruments
Burlington Inst. Co.
Clough-Brengle Co.
Cole Instrument
Dale Instruments
De Jur Amsco Corp.
Electro-Tech Equip. Co.
Electronic Development
Electronic Dev. Lab.
Esterline-Angus Co.
Feiler Engineering
General Elec. Co.
Hickok Elec. Inst. Co.
International Instrument
Lewis Engineering
Meters, Inc.
National Tech. Labs.
Precision Apparatus Co.
Radio City Products
RCA Div.
Rawson Electrical Inst.
Reiner Electronics
Reliance Instrument Co.
Roller-Smith Co.
Sangamo Electric
Schauer Machine Co.
Sensitive Research Inst.
Simpson Electric Co.
Sticht Co.
Supreme Instruments
Triplett Electrical Inst.
U. S. Gauge
Welch Scientific
Westinghouse Elec.
Weston Elec. Inst. Corp.
Wheelco Instrument

VOLT-AMPERE-HOUR METERS
Ferranti Electric, Inc.
General Electric Co.
Roller-Smith
Sangamo Electric
Westinghouse Elec.

VOLT-AMPERE METERS, REACTIVE
Cole Instrument
Electrical Facilities, Inc.
Esterline-Angus Co.
General Elec. Co.
Hickok Elec. Instrument
Landis & Gyr, Inc.
Sangamo Electric
Sensitive Research Inst.
Triplett Elec. Inst.
Westinghouse Elec.
Weston Elec. Inst.

MILLIVAC VACUUM TUBE MILLIVOLT METERS

DC & RF Millivolts.
DC Micromicro-Amperes.
SPECIAL DC AMPLIFIERS
(Modulator Type Vacuum Tube Meters)

MV-17A DC Millivolt Meter
- One Millivolt Full Scale—1000 V—13 Ranges
- Input Impedance—6 megohms on lowest scales 60 megohms on 1 V and up
- Stable Zero—no adjustment required above 10 mV

MV-18A RF & DC Millivolt Meter
- 1 MC to 200 MC flat within 10%, useful to 2500 MC with chart
- 10 mV to 1000 V RF directly calibrated, 1 mV to 10 mV by chart
- 1 mV, 2.5 mV, 10mV Full Scale DC Ranges

MV-171 Shunt Box for either MV-17A or MV-18A
- Reads 0.00001 microamperes DC to 10 amperes
- Twenty-three separate ranges
- Measures resistances up to 100 meg-meg ohms

MILLIVAC INSTRUMENTS
BOX 3027 NEW HAVEN, CONN.

VOLTMETERS, A-c. Rectifier
Ballantine Labs.
Bradshaw Instruments
Burlington Instrument
Dale Instruments
De Jur-Amsco Corp.
General Electric Co.
General Radio Co.
Hewlett-Packard
International Instrument
Marion Electrical Inst.
Meters, Corp.
Roller-Smith
Simpson Electric Co.
Sterling Mfg. Co.
Triplett Elec. Inst.
U. S. Gauge Co.
Welch Scientific
Westinghouse Elec.
Weston Elec. Inst. Corp.

VOLTMETERS, Contact Making
Assembly Products
De Jur-Amsco
Cole Instrument
Edison Electrical Controls
Electric Des. & Mfg.
Electric Laboratory
Electric Tachometer Corp.
Electronic Development
Engineering Labs., Inc.
Esterline-Angus Co.
Ferranti Electric, Inc.
General Electric Co.
Geophysical Instrument Co.
Hickok Electrical Inst.
Lewis Engineering
Reliance Instrument Co.
Roller-Smith Co.
Triplett Elec. Inst.
Weston Electrical Inst.
Wheelco Instrument

VOLTMETERS, Electrostatic
Assembly Products
Cambridge Inst. Co.
Cole Instrument
Ferranti Electric, Inc.
General Elec. Co.
Hathaway Inst. Co.
Hickok Elect. Inst. Co.
Rawson Electrical Inst.
Sensitive Research Inst.
Sticht Co.

VOLTMETERS, Indicating
Assembly Products
Associated Research
Ballantine Labs.
Beede Elec. Instrument
Burlington Inst. Co.
Chicago Indust. Inst.
Clough-Brengle Co.
Cole Instrument
Columbia Elec. Mfg.
Control Corp.
Dale Instruments
De Jur-Amsco Corp.
Electric Des. & Mfg.
Electronic Development
Espey Mfg.
Ferranti Electric, Inc.
General Elec. Co.
Hickok Elec. Inst. Co.
International Instrument
J-B-T Insts.
Lewis Engineering
Marion Electrical Inst.
Meters, Inc.
Miller, M. C.
Niagara Electrical Inst.
Norton Electrical Inst.
Precision Apparatus Corp.
Radio City Products Co.
Rawson Electrical Inst.
RCA Manufacturing Co.
Reiner Instrument
Reliance Instrument
Roller-Smith Co.
Sensitive Research Inst.
Shelby Inst.
Simpson Elec. Co.
Sterling Mfg. Co.
Sticht Co.
Sun Electric Corp.
Taco West Corp.
Triplett Elec. Inst.
Triumph Mfg. Co.
U. S. Gauge
Welch Mfg. Co.
Westinghouse Elec.
Weston Elec. Inst. Corp.
Wheelco Instrument
Winslow Co.

VOLTMETERS, Laboratory Standard
Ballantine Labs.
Burlington Instrument
Ferranti Electric
General Electric Co.
Measurements Corp.
National Tech. Labs.
Rawson Elec. Inst.
Roller-Smith Co.
Sensitive Research Inst.
U. S. Gauge Co.
Welch Scientific
Weston Elec. Inst. Corp.

VOLTMETERS, Megohm
Assembly Products
Beede Elec. Instrument
Cole Instrument
Dale Instruments
Daven Co.
Delmhorst Instrument
Electro Products Lab.
Electro-Tech. Equip. Co.
Electronic Dev. Lab.
General Radio Co.
Hickok Elect. Inst. Co.
Industrial Insts. Inc.
Jackson Electrical Inst.
National Tech. Labs.
Precision Apparatus
Rawson Electrical Inst.
RCA Div.
Rowe Engineering
Sensitive Research Inst.
Shallcross Mfg. Co.

(Continued)

Sticht Co.
Sun Manufacturing
Triplett Elec. Inst.
Welch Mfg. Co.
Westinghouse Elec.
Weston Elec. Inst. Corp.

VOLTMETERS, Micro
Ballantine Labs.
Cambridge Inst. Co.
Cole Instrument
Dale Instruments
De Jur-Amsco Corp.
General Electric Co.
General Radio Co.
Hickok Elec. Inst. Co.
Microvolts, Inc.
Rawson Electrical Inst.
Sensitive Research Inst.
Supreme Instruments
Televiso Co.
Triplett Elec. Inst.
Welch Scientific
Weston Elec. Inst. Corp.
Wheelco Inst. Co.

VOLTMETERS, Micro, Radio Frequency
Ballantine Labs.
Burlington Inst. Co.
Clarke Inst. Corp.
Cole Instrument
Electric Des. & Mfg.
Ferris Inst. Corp.
General Elec. Co.
General Radio Co.
Hickok Elec. Inst. Co.
Rollin Co.
Sensitive Research Inst.
Sylvania Elec. Prods.
Triplett Elec. Inst.

VOLTMETERS, Millivoltmeters
Assembly Products
Ballantine Labs.
Bristol Co.
Brown Instrument Div.
Burlington Inst. Co.
Cambridge Inst. Co.
Cole Instrument
Commercial Research
Dale Instruments
De Jur-Amsco Corp.
Electric Des. & Mfg.
Electronic Development
Engelhard, Chas.
Esterline-Angus Co.
Foxboro Co.
Freed Transformer
General Elec. Co.
Hickok Elec. Inst. Co.
International Instrument
J-B-T Insts.
Lewis Engineering
Marion Electrical Inst.
Meters, Inc.
Miller, M. C.
Millivac Instruments
National Tech. Labs.
Radio-City Products Co.
Rawson Electrical Inst.
RCA Manufacturing
Reiner Electronics
Reliance Instrument
Roller-Smith
Sensitive Research Inst.
Shallcross Mfg. Co.
Simpson Elec. Co.
Southwestern Ind. Elec.
Standard Science Sup.
Sun Manufacturing
Taco West Corp.
Thwing-Albert Inst. Co.
Triplett Electrical Inst.
Welch Scientific
Westinghouse Elec.
Weston Elec. Inst. Corp.
Wheelco Inst. Co.

VOLTMETERS, Millivoltmeters, A-c. Rectifier
Ballantine Laboratories
Burlington Instruments
Dale Instruments
De Jur-Amsco Corp.
Electronic Development
Hewlett-Packard
International Instruments
Marion Electrical Inst.
National Tech. Labs.
Prec. Apparatus Co.
Roller-Smith Co.
Triplett Elec. Instrument
Welch Scientific
Westinghouse Elec.
Weston Elec. Inst. Corp.

VOLTMETERS, Oxide Rectifier
Assembly Products
Clough-Brengle Co.
Cole Instrument
Dale Instruments
De Jur-Amsco Corp.
Electric Des. & Mfg.
Electronic Dev. Lab.
Feiler Engineering
General Elec. Co.
General Radio Co.
Hickok Elec. Inst. Co.
Marion Electrical Inst.
Meters, Inc
Precision Apparatus
Radio City Products Co
Reiner Electronics
Reliance Instrument
Roller-Smith
Simpson Elec Co.
Sun Manufacturing
Supreme Instruments
Taco West Corp.
Triplett Electrical Inst.
Triumph Mfg. Co.
Welch Scientific
Westinghouse Elec.
Weston Elec. Inst. Corp.

VOLTMETERS, Peak
Ballantine Labs.
Barber Labs., Alfred
Clarke Inst. Corp.
Clough-Brengle Co.
Cole Instrument

(Continued)

THE BALLANTINE ELECTRONIC VOLTMETER, DECADE AMPLIFIER AND MULTIPLIERS

10 MICROVOLTS to 10,000 VOLTS

ONE BILLION TO ONE—This enormous range of AC voltages—is easily covered by the Model 300 Voltmeter, Model 220 Decade Amplifier and Model 402 Multipliers illustrated above. The accuracy is 2% at any point on the meter scale, over a frequency range of 10 cycles to 150 kilocycles. The Model 300 Voltmeter (AC operated) reads from .001 volt to 100 volts, the Model 220 Amplifier (battery operated) supplies accurately standardized gains of 10x and 100x and the Model 402 Multipliers extend the range of the voltmeter to 1,000 and 10,000 volts full scale.

Descriptive Bulletin No. 10 Available

BALLANTINE LABORATORIES, INC.

BOONTON, NEW JERSEY, U.S.A.

Electronic Dev. Lab.
Feiler Engineering
General Elec. Co.
General Radio Co.
Hickok Elec. Inst. Co.
Measurements Corp.
Rawson Elec. Instrument
RCA Mfg. Co.
Rowe Engineering
Sensitive Research Inst.
Triplett Elec. Inst.

VOLTMETERS, Recording
Alfax Paper & Engrg.
Bristol Co.
Brush Development
Cambridge Inst. Co.
Cole Instrument
Engelhard, Chas.
Esterline-Angus Co.
General Elec. Co.
Leeds & Northrup Co.
Mass Labs.
Roller-Smith
Sanborn Co.
Southwestern Ind. Elec.
Sound Apparatus
Sticht Co.
Westinghouse Elec.
Wheelco Instrument

VOLTMETERS, Thermionic Rectifier
Barber Labs., Alfred
Cambridge Inst. Co.
Clippard Inst. Lab.
Cole Instrument
Electronic Dev. Lab.
General Elec. Co.
General Radio Co.
Measurements Corp.
Meters, Inc.
Triplett Elec. Inst.

VOLTMETERS, Thermo
Am. Elec. Sales Co.
Assembly Products
Cambridge Inst. Co.
Cole Instrument
Dale Instruments
De Jur-Amsco Corp.
Electronic Development
General Elec. Co.
Hickok Elec. Inst. Co.
Lewis Engineering
Meters, Inc.
Rawson Electrical Inst.
Sensitive Research Inst.
Sun Manufacturing
Triplett Electrical Inst.
Welch Scientific
Westinghouse Elec.
Weston Elec. Inst. Corp.
Wheelco Inst. Co.

VOLTMETERS, Vacuum Tube
Aerovox Corp.
Ballantine Labs.
Barber Labs., Alfred
Bradshaw Instruments
Cambridge Inst. Co.
Clippard Inst. Lab.
Clough-Brengle Co.
Cole Instrument
Dayton Acme Co.
Electronic Dev. Lab.
Electronic Mfg. Co.
Electro Products Lab.
Feiler Engineering
Freed Transformer
General Elec. Co.
General Radio Co.
Hewlett-Packard
Hickok Elec. Instrument
Instrument Electronics
Jackson Elec. Co.
Measurements Corp.
Millen Mfg. Co.
Miller, M. C.
Millivac Instruments
National Tech. Labs.
Precision Apparatus Co.
Radio City Products Co.
RCA Div.
Reiner Electronics
Rowe Radio Research
Schottland, Frederic D.
Shallcross Mfg. Co.
Sherron Metallic
Southwestern Ind. Elec.
Sylvania Elec. Prod.
Televiso Co.
Triplett Electrical Inst.
Triumph Mfg. Co.
Victoreen Instrument
Welch Scientific
Weston Elect. Inst. Corp.

VOLT-OHMMETERS
Asembly Products
Associated Research
Beede Elec. Instrument
Bradshaw Instruments
Burlington Inst. Co.
Chicago Indust. Inst.
Clippard Inst. Lab.
Clough-Brengle Co.
Cole Instrument
Dale Instruments
DeJur-Amsco Corp.
Electronic Dev. Lab.
Feiler Engineering
General Elec. Inst. Co.
Hickok Elec. Inst. Co.
Instruments Labs.
Jackson Electrical Inst.
Meters, Inc.
National Tech. Labs.
Precision Apparatus Corp.
Radio City Prod.
Rawson Electrical Inst.
RCA Div.
Reiner Electronics
Roller-Smith
Sensitive Research Co.
Shallcross Mfg. Co.
Sherron Metallic
Simpson Elec. Co.
Stitcht Co.
Superior Instruments
Taco West Corp.
(Continued)

Triplett Electrical Inst.
Triumph Mfg. Co.
Universal Inst. Co.
Welch Scientific
Westinghouse Elec. & Mfg.
Weston Elec. Inst. Corp.

VOLT-OHM-MILLIAMMETERS
Bradshaw Instruments
Dale Instruments
Electronic Development
International Instruments
Instruments Labs.
Jackson Elec. Inst.
Marion Electrical Inst.
Meters, Inc.
Millivac Instruments
Precision Apparatus Co.
RCA Div.
Roller-Smith Co.
Simpson Electric Co.
Triplett Elec. Instrument
Welch Scientific
Westinghouse Elec.
Weston Elec. Inst. Corp.

VOLUME CONTROLS
Arca Regulators
Askania Regulator Co.
Carter Radio Div.
Centralab Div.
Clarostat Mfg. Co.
Daven Co.
General Radio Co.
Internat'l Resistance
Mallory & Co.
Poole Mfg.
Shallcross Controls
Shallcross Mfg. Co.
Southwestern Ind. Elec.
Triumph Mfg. Co.
U. S. Gauge
Utah Radio Prods.

VOLUME INDICATORS Sound
Amplifier Co.
Cole Instrument
Dale Instruments
Daven Co.
Electronic Development
General Radio Co.
Meters, Inc.

WATCHES, Chronometer
Bliss & Co.
Clebar Watch Co.
Ducommun Co.
Elgin National Watch
Hamilton Watch Co.
Jaeger Watch Co.
Jardur Import Co.
Negus, T. S. & J. D.
Pastor Stop Watch
Sticht Co.
Stillman Co.
Technical Instruments
Waltham Watch

WATCHES, Comparing
Clebar Watch Co.
Ducommun Co.
Elgin National Watch
Hamilton Watch Co.
Jardur Import Co.
Negus, T. S. & J. D.
Waltham Watch Co.

WATCHES, Navigation
Clebar Watch Co.
Ducommun Co.
Elgin National Watch
Hamilton Watch Co.
Jardur Import Co.
Meridian Instrument
Negus, T. S. & J. D.
Waltham Watch Co.

WATCHES, Stop
Aristo Import Co.
Biddle Co., James G.
Central Scientific Co.
Clebar Watch Co.
Ducommun Co.
Elec. Facilities, Inc.
Elgin National Watch
Fish-Schurman Co.
Fisher Scientific Co.
Gaertner Scientific Corp.
Gallien, R. P.
Hamilton Watch
Jaeger Watch Co.
Jardur Import Co.
Negus, T. S. & J. D.
Pastor Stop Watch Co.
Pierce Scientific Co.
Precision Scientific Co.
Racine & Co., Jules
Scherr Co., Inc.
Speidel & Co.
Standard Elec. Time
Sticht Co.
Stillman Co.
Stoelting Co., C. H.
Tagliabue Corp., C. J.
Testrite Instrument Co.
Waltham Watch
Warren Telechron
White Co.
Zernickow Co., O.

WATCHES, Stop-Electric
Central Scientific Co.
Clebar Watch Co.
Elgin Natl. Watch Co.
Jaeger Watch Co.
Jardur Import
Precision Scientific Co.
Standard Elec. Time
Stichi Co.
Stillman Co., M. J.
Stoelting Co., C. H.
Tagliabue Corp., C. J.
Thompson Clock Co.
Waltham Watch

WATER ANALYSIS OUTFITS
Aloe Co., A. S.
Hagan Corp.
Hellige, Inc.
Howe & French, Inc.
La Motte Chemical Prods.
National Tech. Labs.
Taylor & Co., W. A.

WATER BATHS, Constant Temperature (see Viscosimeter Baths)

WATER FEEDERS Automatic
Askania Regulator Co.
Bailey Meter Co.
Belfield Dev.
Climax Engineering
Fischer & Porter
Henszey & Co.
Kiely & Muller
Mason-Neilan Regulator
McAlear Mfg.
Merritt Eng. & Sales Co.
Northern Equip. Co.
Penberthy Injector Co.
Photoswitch, Inc.
Watts Regulator Co.

WATER METERS (See Liquid Meters)

WATER METER TESTERS (See Testers, Water Meter)

WATER & SEDIMENT APPARATUS
Aloe Co., A. S.
Barnstead Still
Central Scientific Co.
Davis Reg. Co.
Henry Valve
Instruments Corp.
McAlear Mfg. Co.
Precision Scientific Co.
Tagliabue Corp., C. J.
Thomas Co., Arthrur H.

WATTHOUR METERS see Meters, Watt-Hour

WATTHOUR METER TESTERS (See Testers Watthour Meter)

WATTMETERS, Electrostatic
General Electric Co.
Hickok Elec. Instrument
Sensitive Research Inst.

WATTMETERS, Indicating
Autocall Co.
Cole Instrument
General Elec. Co.
Hickok Elec. Inst. Co.
Landis & Gyr
Niagara Elec. Inst.
Norton Electrical Inst.
Rawson Electrical Inst.
Reliance Instrument Co.
Rowe Engineering
Roller-Smith Co.
Sensitive Research Inst.
Sticht Co.
Welch Scientific
Triplett Elec. Inst.
Westinghouse Elec.
Weston Elec. Inst. Corp.

WATTMETERS, Laboratory Standard
Bird Electronic
Electrical Facilities Inc.
General Electric Co.
Rawson Elec. Inst.
Roller-Smith Inst.
Triplett Elec. Instrument
Welch Scientific

WATTMETERS, Microwave
Bird Electronic
Hewlett-Packard Co.
Rollin Co.
Sperry Gyroscope Co.

WATTMETERS, Recording
Bristol Co.
Cole Instrument
Esterline Angus Co.
General Elec. Co.
Hathaway Instrument
Hickok Elec. Inst.
Roller-Smith
Sensitive Research Inst.
Sticht Co.
Westinghouse Elec.

WATTMETERS, Reactive
Esterline-Angus
General Electric Co.
Roller Smith
Westinghouse Elec.

WAVE METERS
Clarke Inst. Corp.
Electronic Dev. Lab.
Federal Telephone
General Electric
General Radio Co.
Jones Electronics
Millen Mfg. Co.
RCA Manufacturing
Sperry Gyroscope Co.

WAX MELTING APPARATUS
Central Scientific Co.
Fisher Scientific Co.
Koehler Instrument
Precision Scientific Co.
Tagliabue Corp., C. J.

WEIGHT INDICATORS, Automatic Recording
Exact Weight Scale Co.
Foxboro Co.
Howe Scale Co.
Merrick Scale Mfg.
Roller-Smith Co.
Streeter-Amet Co.
Toledo Scale Co.

WEIGHING MACHINES (See various headings under "Scales—")

WEIGHTS, Analytical
Ainsworth & Sons
Aloe Co., A. S.
Becker Div., Christian
Central Scientific Co.
Dietert Co.
Exact Weight Scale Co.
Fisher Scientific Co.
Goetz Niemer Co.
Gurley, W. & L. E.
(Continued)

Howe Scale Co.
Ohaus Scale Corp.
Roller Smith
Seedburo Equipment
Seederer-Kolbusch, Inc.
Thomas Co., Arthur H.
Thompson Balance
Torsion Balance Co.
Troemmer, Henry
Voland & Sons, Inc.
Welch Mfg. Co.

WEIGHTS, Avoirdupois
Becker Div., Christian
Central Scientific Co.
Exact Weight Scale Co.
Gurley, W. & L. E.
Howe Scale Co.
Ohaus Scale Corp.
Seederer-Kohlbusch, Inc.
Toledo Scale Co.
Torsion Balance Co.
Troemmer, Henry
Voland & Sons, Inc.

WEIGHTS, Metric
Ainsworth & Sons
Becker Div., Christian
Central Scientific Co.
Chicago Apparatus Co.
Exact Weight Scale Co.
Gaertner Scientific Corp.
Gurley, W. & L. E.
Humboldt Mfg. Co.
Ohaus Scale Corp.
Seederer-Kohlbusch, Inc.
Suter, Alfred
Thompson Balance
Toledo Scale Co.
Torsion Balance Co.
Troemmer, Henry
Voland & Sons, Inc.
Welch Scientific Co.

WEIGHTS, Test (See Weights, Avoirdupois, Metric or Troy)

WEIGHTS, Troy
Becker Div., Christian
Central Scientific Co.
Exact Scale Co.
Gurley, W. & L. E.
Howe Scale Co.
Ohaus Scale Corp.
Seederer-Kohlbusch, Inc.
Toledo Scale Co.
Thompson Balance
Troemmer, Henry
Voland & Sons

WEIGHTS & MEASURES PRECISION STANDARD
Gurley, W. & L. E.
Jacobs Bros. Co.
Pfaltz & Bauer, Inc.
Seederer-Kohlbusch, Inc.
Thompson Balance
Torsion Balance Co.
Troemmer, Henry
Voland & Sons

WEIR METERS (See Flowmeters, Weir)

WELLS, Thermocouple see Tubes, Pyrometer

WIND DIRECTION & VELOCITY INDICATORS
Alfax Paper & Eng.
Doelcam Corp.
Electric Speed Ind. Co.
Elec. Tachometer Corp.
Friez Instrument
General Elec. Co.
Geophysical Inst. Co.
Green, Henry J.
Hastings Inst. Co.
Hays Corp.
Illinois Testing Labs.
Kenyon Instrument Co.
Stevens, C.
Taylor Instrument Cos.
Westberg Mfg. Co.
Westinghouse Elec.

WIND DIRECTION & VELOCITY RECORDERS
Doelcam Corp.
Elec. Tachometer Corp.
Esterline-Angus Co.
Friez Instrument
General Electric Co.
Geophysical Instrument
Green, Henry J.
Hastings Inst. Co.
Hays Corp.
Hickok Elec. Instrument
Illinois Testing Labs.
Instruments Corp.
Kenyon Instrument Co.
Leeds & Northrup Co.
Stewart, M. C.
Wallace & Tiernan
Westinghouse Elec.
Zeiss, Inc., Carl.

WIND GAGES (See Gages, Wind)

WIRES, Gear Measuring
Acme Industrial
Van Keuren Co.
Size Control Co.

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Distillation Products, Inc.
Farrand Optical Co.
General Elec. X-Ray
Hayes Scientific App.
Jarrel-Ash Co.
North Amer. Phillips
Picker X-Ray
RCA Div.
Summers Gyroscope
Wyland, G. C.

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Aloe Co., A. S.
Baird Associates
Bar-Ray Products
Campbell Electric
Fish-Schurman Co.
Gen. Elec. X-Ray Corp.
Goetze Niemer Co.
Hayes Scientific App.
High Voltage Eng.
Industrial X-Ray Labs.
Jarrell-Ash Co.
Kelley-Koett Mfg. Co.
North Amer. Philips
Patterson Screen Co.
Picker X-Ray
Shallcross Mfg. Co.
Stoelting Co., C. H.
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Technical Associa
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X-RAY SPECTROGRAPHS (See Spectrographs, (X-Ray)

X-RAY SPECTROMETERS

X-RAY STEREOSCOPE (See Stereoscope, X-Ray)

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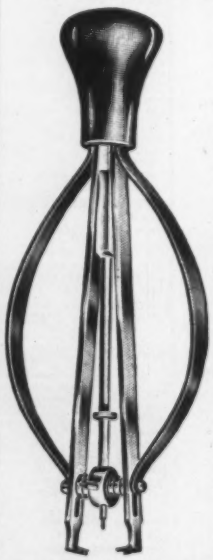

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Accuracy Scientific Instruments Co., 2903 N. 12th St., Philadelphia 33, Pa.
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(See advertisement on page 103)

Accurate Pyrometric Cone Co., Pataskala, Ohio
Seger cones

Accurate Instrument Co., Inc. 3456 N. Clark St., Chicago 13, Ill
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Ace Glass Inc., Vineland, N. J.
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Acme Regulator Co., Box 268, Tulsa 1, Okla.
High Pressure regulators

Acme Scientific Co., 1450 West Randolph St., Chicago 7, Ill.
Optical flats and light sources

Acro Switch Co., 13th & Superior, Cleveland 14, O.
Snap action switches

Adams & Westlake, Elkhart, Ind.
Relays

Adde & Co., 57 Kennebec St., Portland 2, Maine
Counters

Adel Precision Products Corp., 10777 Van Owen St., Burbank, Calif.
Hydraulic actuators and remote control equipment

Advance Electric & Relay Co., 1260 W. Second St., Los Angeles 26, Calif.
Relays
(See advertisement on page 87)

Aero Instrument Co., 5105 Denison Ave., Cleveland 2, Ohio
Airspeed tubes

Aerolite Electronic Hardware Corp., 24 Cliff St., Jersey City, N. J.
Radio hardware, connectors

Aeroquip Corp., 300 South East St., Jackson, Mich.

Aerovox Corporation, New Bedford, Mass.
Capacitors & resistors

Agfa Ansco, Binghamton, N. Y.
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Ahrendt Instrument Co., 143 Kennedy St., N. W., Washington 11, D. C.
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Air Instrument Corp., 1562 Main St., Springfield, Mass.
Height Gages

Aircraft Electronics Associates, Inc., 1031 New Britain Ave., Hartford 10, Conn.
Aircraft instruments and testers

Aircraft-Marine Products, Inc., 1521-39 No. 4th St., Harrisburg, Pa.
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Airdesign & Fabrication Incorporated, 241 Fairfield Ave., Upper Darby, Pa.
Audio-frequency equipment, transformers

Airdraulics Engineering, Inc., New Canaan, Conn.
Torque Testers

Airflo Instrument Co., 122 Naubuc Ave., Glastonbury, Conn.
Special probes for measuring gas velocity, direction, temperature and pressure

Airite Products Co., Inc., 3328 Union Pacific Ave., Los Angeles 23, Calif.
Fire detectors

Airplane & Marine Instruments, Inc., Clearfield, Pa.
Absolute pressure gage
(See advertisement on page 49)

Alden Products Co., Inc., 117 N. Main St., Brockton 64, Mass.
Oscillographs, radiosondes, fascimile recorders

Alfab Manfacturing Co., 8320 Millet St., Houston 12, Texas
Laboratory furniture

Alfax Paper & Engg. Co., 40 Riverside Ave., Brockton, Mass.
Accelerometers, barometers & clinometers
(See advertisement on page 84)

All American Tool & Mfg. Co., 1014 W. Fullerton Ave., Chicago 14, Ill.
Vibration fatigue testers

Allen-Bradley Co., 136 W. Greenfield St., Milwaukee 4, Wis.
Electric control apparatus

Allied Control Co., Inc., 2 East End Ave., New York 21, N. Y.
Relays, switches & remote control equipment

Allied Engraving & Stamping Co., 100 Perry St., Buffalo 4, N. Y.
Instrument panels

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Amplifiers and audio-frequency equipment

Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.
Position indicators, frequency load & phase regulators

Aloe Co., A. S., 1819 Olive St., St. Louis 3, Mo.
Laboratory supplies

Alpha Instrument Co., 2103 K St., N. W., Washington 7, D. C.
Meteorological Instruments

Alpha-Lux Co., Inc., 155 John St., New York, N. Y.
Moisture testers

Altender & Sons, Theo., 1219 Spring Garden St., Philadelphia 23, Pa.
Drawing instruments

American Blower Corp., 6000 Russell St., Detroit 32, Mich.
Manometers

American Chain & Cable Co., Helcoid Gage Div., 929 Connecticut Ave., Bridgeport 2, Conn.
Bourdon tube gages & pressure indicators
(See advertisement on page 51)

American Communications Corp., 308 Broadway, New York 7, N. Y.
Audio-frequency equipment, battery chargers, instrument panels

American Condenser Co., 4410 Ravenwood Ave., Chicago, Ill.
Capacitors

American Cystoscope Makers, Inc., 1241 Lafayette Ave., New York 59, N. Y.
Bore inspection devices and internal surface inspection devices

American District Steam Co., Bryant St., North Tonawanda, N. Y.
Steam flowmeters

American Gage Co., 143 17th Ave., Paterson 3, N. J.
Profile, ring and snap gages

American Gas Accumulator Co., 1029 Newark Ave., Elizabeth, N. J.
Time delay relays

American Indicator-Paper Co., 4611 N. Kostner Ave., Chicago 30, Ill.
Chemical indicator papers

American Instrument Co., 8010-8020 Georgia Ave., Silver Spring, Md.
Scientific instruments & materials testing apparatus

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Cathode-ray tubes and lenses

American Measuring Instruments Corp., 240 W. 40th St., New York 18, N. Y.
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Tinned case & ironcase positive displacement gas & air meters, pressure reducing regulators, meter testing apparatus, indicating, recording & integrating flowmeters, rate volume & liquid level controllers & remote controllers
(See advertisement on page 47)

American Optical Co., Scientific Instrument Div. Box A, Buffalo 15, N. Y.
Scientific optical instruments, projection apparatus, testing equipment and optical parts, microscopes, microtomes, refractometers, spectrometers, visual colorimeters, illuminators, delineascopes, magnifiers, and special lenses, prisms and mirrors for industrial and educational purposes.

American Paulin System, 1874 So. Flower St., Los Angeles 15, Calif.
Meteorological instruments
(See advertisement on page 26)

American Temperature Indicating Co., 1017 Summit St., Toledo 4, Ohio
Electrical resistance thermometers

American Thermo-Electric Co., 67 East 8th St., New York 3, N. Y.
Vacuum, separate heater & contact type thermocouples
(See advertisement on page 101)

American Thermostat Corp. 34-14 34th Ave. Long Island City 1, N. Y.
Thermostats

American Time Corp., 134 Chestnut St., Springfield 1, Mass.

American Time Products, Inc., 580 Fifth Ave., New York 19, N. Y.
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American Transformer Co., 178 Emmet St., Newark, N. J.
Transformers & electrical apparatus including voltage regulators, high voltage testing sets, rectifiers

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Gas and vapor discharge tubes

Amperite Corp., 561 Broadway, New York 12, N. Y.
Microphones

Amplifier Corp. of America, 398 Broadway, New York 13, N. Y.
Amplifiers

Amthor Testing Instrument Co., Inc., 48 Van Sinderen Ave., Brooklyn 7, N. Y.
Physical testing machines
(See advertisement on page 97)

Analysis Sales Co., 1827 Union Commerce Bldg., Cleveland 14, Ohio
Impact recorders

Anders Company, 420 Lexington Ave., New York, N. Y.
Instrument ' airdryers
(See advertisement on page 118)

Anderson, Arthur R., 110 Woodbury Ave., Springdale (Stamford), Conn.
Strain gages

Anderson Bros. Mfg. Co., 1910 Kishwaukee St., Rockford, Ill.
Balancing machines

Annin Company, 3234 Mines Ave., Los Angeles 23, Calif.
Control valves

Annis Company, R. B., 1101 N. Delaware St., Indianapolis, Ind.
Permeameters, balancing machines

Ansonia Clock Co., Inc., 103 Lafayette St., New York, N. Y.
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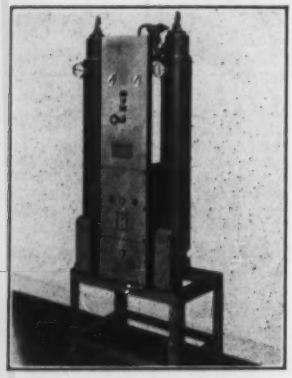

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Arrow-Hart & Hegeman Electric Co., 103 Hawthorne St., Hartford 7, Conn.
Magnetic, mercury & relay switches

Ashcraft Automatic Control Co., 1415 Howard St., Chicago 26, Ill.
Automatic controls

Ashton Valve Company, 161 First St., Cambridge, Mass.
Pop safety & relief valves, pressure gages, gage testers & master pilot & master pressure gages

Askania Regulator Co., 240 E. Ontario St., Chicago 11, Ill.
Automatic control instruments
(See advertisement on page 32)

Assembly Products, Inc., Main & Bell Sts., Chagrin Falls, Ohio
Electrical indicating instruments and accessories
(See advertisement on page 23)

Associated Research, Inc. 3758 W. Belmont Ave., Chicago 18, Ill.
Vibrotest insulation testing equipment. Special measuring & testing instruments of electrical nature.
(See advertisement on page 100)

Atlas Electric Devices Co., 361 West Superior St., Chicago 10, Ill.
Fade-Ometer, Weather-Ometer, Launder-Ometer

Atlas Exploration Co., 1911 West Alabama St., Houston 6, Texas
Geophysical instruments

Atlas Valve Co., 282 South St., Newark 5, N. J.
Regulator valves

Atomic Instrument Co., 160 Charles St. Boston, Mass.
Radioactive detectors and electronic instruments
(See advertisement on page 24)

Audio Development Co., 2833 13th Ave., Minneapolis 7, Minn.
Transformers, audio frequency equipment

Audio Instrument Co., 1947 Broadway, New York 23, N. Y.
Audio-frequency equipment

Audio-Tone Oscillator Co., 237 John St., Bridgeport 3, Conn.
Radio Test Instruments

Auth Electrical Specialty Co., Inc., 422 E. 53 St., New York 22, N. Y.
Signaling devices

Autocall Co., Shelby, Ohio
Electrical signaling, control & metering devices

Autoclave Engineers, Inc., P. O. Box 1027, Erie, Pa.
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Automatic Control Co., 1005 University Ave., St. Paul 4, Minn.
Circuit switches for automatic level controls, automatic timing & sequence controllers

Automatic Electric Mfg. Co., Mankato, Minn.
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Automatic Electric Sales Corp. 1033 W. Van Buren St., Chicago 7, Ill.
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Automatic Scale Co., Inc., 591 Hudson St., New York 14, N. Y.
Automatic scales

Automatic Switch Co., High St. & Lakeside Ave., Orange ,N. J.
Solenoid operated valves & automatic electric control apparatus

Automatic Temperature Control Co., Inc., 5212 Pulaski Ave., Philadelphia 44, Pa.
Timers, time control and specialty engineering. Valves & valve controllers, various types of relays.
(See advertisement on pages 21, 40, 41, 42)

Automatic Valve Controller Co., Box 268, Tulsa 1, Okla.
Automatic valve control

Autotron Co., Danville, Ill.
Automatic inspection devices

B

Bacharach Industrial Instrument Co., 7000 Bennett St., Pittsburgh 8, Pa.
Industrial instruments
(See advertisement on pages 21, 59, 104)

Bache & Company, Semon, 636-638 Greenwich St., New York 14, N. Y.
Glass and mirrors of all types
(See advertisement on page 61)

Badger Meter Mfg. Co., 2371 North 30th St., Milwaukee 10, Wis.
Liquid meters

Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland 10, Ohio
Metering & control equipment for power plants & industrial processes. Power plant instruments; boiler meter, meter combustion control operating directly from boiler meter, three-element feed water control, steam superheat contrpl, desuperheating & pressure reducing control. Also metering & control equipment for sewage treatment, water supply & process industries
(See advertisement on pages 26, 31, 32, 42, 45, 48, 49, 79)

Baird Associates, 33 University Road, Cambridge 38, Mass.
Specialized physical & optical instruments including complete line of spectrographic & x-ray diffraction equipment

Baker Compass Co., Melrose, Mass.
Compasses

Baldwin Locomotive Works, Eddystone, Pa.
Universal testing machines

Ballantine Labs., Inc., Boonton, N. J.
Artificial ears, electronic voltmeters, sound meters, vibration pickups, throat microphone, telephone receiver test equipment
(See advertisement on page 115)

Bar-Ray Products, Inc., 209 25th St., Brooklyn, N. Y.
X-ray equipment

Barber-Colman Co., Rockford, Ill.
Automatic controlling instruments for temperature, humidity, pressure, liquid level, moisture regain, motor-operated valves, solenoid valves, electric power units, damper controllers, voltage sensitive relays, associated switches & relays, fractional H. P. motors, geared motor units & hardness testers.

Barber Laboratories, Alfred W., 34-04 Francis Lewis Blvd., Flushing, L. I., N. Y.
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Barbour Stockwell Co., 205 Broadway, Cambridge, Mass.
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Pedestal micrometers

Barr Instrument Co., Inc., 134-39 225 St., Springfield Gardens 13, N. Y.
Dimensional Gages

Barry Corp., 179 Sidney St., Cambridge, Mass.
Vibration mountings and isolators
(See advertisement on page 70)

Barton Instrument Co., 3500 Union Pacific Ave., Los Angeles 23, Calif.
Flowmeters & gages
(See advertisement on page 50)

Bastian-Blessing Co., 4201 W. Peterson St., Chicago 30, Ill.
Regulating valves

Bausch & Lomb Optical Co., 635 St. Paul St., Rochester, N. Y.
Optical instruments for industrial, scientific & educational use including microscopes, colorimeters, refractometers, photomicrographic & metallographic equipment, contour measuring projector, optical glass & special optical systems

Bay Instruments and Development, 2200 Woolsey St., Berkeley 5, Calif.
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Bayside Watch Tool Co., 211-12 Northern Blvd., Bayside, L. I., N. Y.
Machines, tools and dies for watch, clock and instrument industries

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Bear Manufacturing Co., Rock Island, Ill.
Balancing machines

Beck Bros. 421 Sedgely Ave., Philadelphia 40, Pa.
Resistors

Beck Co., Harold 3642 N. Second St., Philadelphia 40, Pa.
Pyrometer controllers
(See advertisement on page 40)

Becker Div., Christian; Torsion Balance Co., 92 Reade St., New York 13, N. Y.
Precision balances & weights, including analytical, assay, magnetically damped, diamond, specific gravity, dairy, druggists, textile.

Becker, Joseph. 3700 Bergenline Ave., Union City, N. J.
Laboratory apparatus

Beede Electrical Instrument Co., Penacook, N. H.
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Belfield Valve Div., Minneapolis-Honeywell Regulator Co., Broad & Hamilton Sts. Philadelphia 23, Pa.
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Bell & Howell Co., 7100 McCormick Rd., Chicago 45, Ill.
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Belco Glass, Inc., 413 N. 4 St., Vineland, N. J.

Berge, J. & H., 145 Hudson St., New York 13, N. Y.
Laboratory supplies

Berger & Sons, Inc., C. L., 37 Williams St., Roxbury, Boston 19 Mass.
Surveying instruments

Berkeley Scientific Co., 601 Nevin Ave., Richmond, Calif.
Radioactivity measurement instruments, & spectrometers

Best Scientific Glass App. Wks., 2449 N. Clybourn St., Chicago 14, Ill.

Bethlehem Foundry & Machine Co., Bethlehem, Pa.
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Better Coils, Inc., Goodland, Ind.
Chokes

Betts & Betts Corp., 551 West 52nd St., New York 19, N. Y.
Multiple circuit timers, controls, time delay relays & motor driven & thermostatic interrupters

Biddle Co., James G., 1316 Arch St., Philadelphia, Pa.
Insulation testers, ground testers & ohmmeters, speed-measuring instruments, frequency meters, sliding-contact rheostats
(See advertisement on page 96)

Bidwell Instrument Co., 1007 Troy Place, N. W., Canton 3, Ohio
Microchemical laboratory apparatus; custom built research instruments.
(See advertisement on page 118)

Bin-Dicator Co., 14615 East Jefferson Ave., Detroit 15, Mich.
Automatic bin level indication & control
(See advertisement on page 118)

Binswanger & Co., 645-655 Union Ave., Memphis 1, Tenn.
Lenses, prisms & filters, Glass of every discription

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Biological supplies

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Black & Webster, Inc., 30 Pleasant St., Needham 92, Mass.
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Blake Co., Edward, 437 Cherry St., West Newton 65, Mass.
Dimensional gages

Bliley Electric Co., 200 Union Station Bldg., Erie, Pa.
Quartz piezo-electric crystals

Bliss & Co., Inc., John, 84 Pearl St., New York 4, N. Y.
Marine instruments

Block Mfg. Co., 1416 W. Baltimore St., Baltimore, Md.

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Laboratory apparatus

Boeskeler Instrument Co., 31 E. Rillito St. Tucson, Ariz.
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(See advertisement on page 69)

Bolsey Corp. of America, 118 E. 25th St., New York, N. Y.
Optical equipment, cameras and projectors

Boonton Radio Corp., P. O. Box 390, Boonton, N. J.
Radio test instruments
(See advertisement on page 83)

Booth Co., A. E., 210 W. 7th St., Ls Angeles 14, Calif.
Portable meter testers
(See advertisement on page 86)

Borden Engineering Co., New Providence, N. J.
Ground resistance meters, pipe locators, signal generators

Boston Auto Gage Co., 70 West St., Pittsfield, Mass.
Liquid level gages and allied lines

Bostrom-Brady Mfg. Co., Stonewall & Bailey Sts., Atlanta, Ga.
Surveying instruments

Boulin Instrument Corp., 65 Madison Ave., New York 16, N. Y.
Chronometric hand tachometers, wound stroboscopes, electrical stroboscopes, speed indicators & portable & stationary tachometers
(See advertisement on page 94)

Bowen & Co., Inc., 4712 Bethesda Ave., Bethesda 14, Md.
Cement testers

Bowser & Co., Inc., S. F., 1302 E. Creighton Ave., Fort Wayne 2, Ind.
Liquid meters

Bowser, Inc., Refrigeration Div., Terryville, Conn.
Testing cabinets, low temperature, high altitude, relative humidity

Boyer-Campbell Co., 6540 Antoine St., Detroit 2, Mich.
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Boylston Steam Specialty Co., 116 W. Illinois St., Chicago 10, Ill
Regulating valves

Brabender Corp., 244 Saddle River Rd., Rochelle, Park, N. J.
Industrial measuring & control apparatus for plastic & viscous materials; semi-automatic moisture testers

Bradley Laboratories, Inc., 82 Meadow St., New Haven 10, Conn.
Photoelectric cells

Bradshaw Instruments Co., 42 Flatbush Ave., Brooklyn 17, N. Y.
Electrical instruments

Branson Instruments, Inc., Joe's Hill Rd., Danbury, Conn.
Thickness gages, tube & sheet metal
(See advertisement on page 57)

Braun Corp., 2260 East 15th St., Los Angeles 21, Calif.
Chemicals & laboratory supplies

Braun-Knecht-Heimann Co., 1400 Sixteenth St., San Francisco, Calif.
Laboratory supplies

Bray Optical Co., 3445 W. 1st. St., Los Angeles 4, Calif.
Lenses, prisms & optical instruments

Breeze Corporation, 24 South 6th St., Newark 7, N. J.
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Bridgeport Thermostat Div., Robertshaw-Fulton Controls Co., 1225 Connecticut Ave., Bridgeport, Conn.
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Brigham Co., R. B., 624 Southard Ave., Toledo 2, Ohio
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Bristol Company, Waterbury 91, Conn.
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(See advertisements on pages 32, 56, 58, 79, 89, 100, 103)

Brodie Co., Inc., Ralph N., 61st & Lowell Sts., Oakland 8, Calif.
Positive displacement petroleum meters & accessories

Brooke Engineering Co., Inc., 4517 Wayne Ave., Philadelphia 44, Pa.

Electrically actuated pressure & flow controllers
Brookfield Engineering Laboratories, 2 Porter St., Stoughton, Mass.
Synchro-Lectric viscosimeter

Brooks Rotameter Co., Box 432, Lansdale, Pa.
Flowmeters

Brown Geophysical Co., P. O. Box 6005, Houston 6, Tex.
Instruments for measuring earth's gravitational field

Brown Instrument Div., Minneapolis-Honeywell Regulator Co., 4482 Wayne Ave., Philadelphia 44, Pa.
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Brown & Sharpe Mfg. Co., Providence 1, R. I.
Machine shop instruments

Browne-Morse Co., Muskegon, Mich.
Laboratory furniture

Browning Laboratories, Inc., 750 Main St., Winchester, Mass.
Frequency meters, signal generators, cathode-ray oscillographs
(See advertisement on page 74)

Bruning Co., Inc., Chas., 4754 Montrose St., Chicago 41, Ill.
Drawing & surveying instruments

Brush Development Co., 3311 Perkins Ave., Cleveland 14, Ohio
Piezoelectric instruments including laboratory microphones, vibration & fluid pulsation pickups, galvanometers, pen oscillographs, surface finish testers, artificial ears, headphones, phonograph pickups & cutters
(See advertisement on page 5)

Bryant Chucking Grinder Co., Springfield, Vt.
Screw thread gages

Buehler and Company, 1230 Loyola St., Chicago 26, Ill.

Buffalo Apparatus Corp., 90 Shenango St., Buffalo 13, N. Y.
Laboratory supplies

Buffalo Meter Co., 2917 Main St., Buffalo 14, N. Y.
Liquid meters for measurement of cold water, hot water, oils, chemicals. Integrating registers, cumulative, setback, or predetermined control.
(See advertisement on page 67)

Buffalo Scale Co., 1200 Niagara St., Buffalo 13, N. Y.
Scales

Builders-Providence, Inc., 9 Codding St., Providence 1, R. I.
Instruments for indicating, recording, controlling flow, liquid level, pressure, temperature, and weight

Bullard Co., E. D., 275 Eighth St., San Francisco 3, Calif.
Gas leak detectors

Bunnell Company, J. H., 81 Prospect St., Brooklyn, N. Y.
Relays & switches

Burgess Battery Co., Freeport, Ill.
Dry Batteries
(See advertisement on pages 6, 27)

Burke Electric Co., Erie, Pa.
Fractional horsepower motors

Burke & James, Inc., 321 S. Wabash; Chicago 4, Ill.
Photographic equipment for research and laboratory departments

Burke, Louis, 41 John St., New York, N. Y.
Stop watches and chronometers

Burling Instrument Co., 251-253 Springfield Ave., Newark 3, N. J.
Temperature controls for laboratories, Industrial processes, furnaces & ovens. (-100° to 1400°F.) Standard tubes or special alloys & ranges.
(See advertisement on page 41)

Burlington Instrument Co., 214½ North 4th St., Burlington, Iowa
Electrical control apparatus

Burndy Engineering Co., 107 Bruckner Blvd., New York 54, N. Y.
Connectors, plugs and jacks

Burrell Technical Supply Co., 1942 Fifth Ave., Pittsburgh 19, Pa.
Scientific instruments & laboratory supplies

Burton Mfg. Co., 3853 N. Lincoln St., Chicago 13, Ill.
Microscopic accessories & bank & turn indicators

B. W. Controller Corp., 2200 E. Maple Rd., Birmingham, Mich.
Floatless liquid level controls

C

Cadillac Gage Co., 20316 Hoover Road, Detroit 5, Mich.
Dimensional gages

Cady & Co., E. J., 134 N. LaSalle St., Chicago 2, Ill.
Non destructive testers for physical properties

Calculagraph Co., 300 Sussex St., Harrison, N. J.
Elapsed time indicator

Calibron Products, Inc., 51 Lakeside Ave., West Orange, N. J.
Special apparatus

Calidyne Co., 751 Main St., Winchester, Mass.
Accelerometers and vibration pickups

Callahan & Co., E. J., 14 W. Barre St., Baltimore 1, Md.
Laboratory supply house

Calta Glass Wks., 2158 Ogden Ave., Chicago 12, Ill.
Scientific glassware

Cambridge Instrument Co., Inc., 3472 Grand Central Terminal, New York 17, N. Y.
Scientific & industrial instruments
(See advertisement on pages 59, 63, 79, 85, 120)

FOR MEASURING RADIOACTIVE EMISSION

LINDEMANN-RYERSON ELECTROMETER, illustrated at left. Compact, sturdy, high sensitivity, stable zero and requires no leveling. Capacitance is about 3 cm. Includes improvements developed by the Ryerson laboratory.

"CHANG & ENG" FAST NEUTRON DETECTOR. Follows closely original design of U. S. Atomic Energy Commission. Consists of twin ionization chambers, Lindemann Electrometer, reading microscope and dry cells. Self-contained.

PRECISION IONIZATION METER. (Failla Design.) A complete instrument for null methods of radioactivity measurement where background effects must be eliminated. Operates from A.C. outlet.

POCKET GAMMA RAY DOSIMETER. A personnel monitoring instrument to measure cumulative exposure to gamma or X-rays over a given period. Contains an ionization chamber, a quartz fibre electrometer and viewing system.

Pioneer Manufacturers of Precision Instruments

CAMBRIDGE INSTRUMENT COMPANY, INC.

3742 GRAND CENTRAL TERMINAL NEW YORK 17, N. Y.

Cameron Surgical Specialty Co., 666 W. Division St., Chicago 10, Ill.
Surgical instruments

Campbell Co., J. A., 645 Wardlow Rd., Long Beach 7, Calif.
Thermometer wells & automatic controllers

Canadian Radium & Uranium Corp., 630 Fifth Ave., New York 20, N. Y.
Luminous, phosphorescent and flourescent paints

Cannon Electric Development Co., 3209 Humboldt St., Los Angeles 31, Calif.
Multiple circuit connectors for instruments
(See advertisement on page 31)

Cargille, R. P., 118 Liberty St., New York 6, N. Y.
Chemical laboratory & photographic devices. Immersion liquids for inspecting glass & quartz

Carson Micrometer Corp., Little Falls, N. J.
Electronic micrometer

Carter Parts Co., 213 Institute Place, Chicago 10, Ill.
Relays, resistors, rheostats & switches

Carver, Fred S., 345 Hudson St., New York 14, N. Y.
High pressure testing devices

Cash Valve Mfg. Co., A. W., Wabash and Morgan, Decatur 90, Ill.
Combustion control instruments
(See advertisement on page 40)

Central Scientific Co., 1700 Irving Park Blvd., Chicago, Ill.
Scientific instruments & laboratory apparatus
(See advertisement on page 112)

Central Station Steam Co., 2910 E. Woodbridge St., Detroit 7, Mich.
Rotary type condensate meter

Centralab Div., Globe Union Inc., 900 E. Keefe Ave., Milwaukee 1, Wis.
Capacitors, rheostats, resistors & switches

Century Geophysical Corp., 1333 N. Utica Ave., Tulsa 6, Okla.
Geophysical instruments
(See advertisement on page 60)

Chace Co., W. M., 1600 Beard Ave., Detroit 9, Mich.
Thermostatic bimetals

Chandler & Stedman, 398 Newton St., Waltham 54, Mass.
Special laboratory apparatus

Chart Production Co., 280 Madison Ave., New York 16, N. Y.
Charts for all types of recording

Charvos-Roos Corp., 101 5th Ave., New York 3, N. Y.
Drawing instruments

Chatillon & Sons, John, 85 Cliff St., New York 7, N. Y.
Iso-elastic springs

Chelsea Clock Company, Chelsea, Mass.
Clocks & clock movements

Chicago Condenser Co., 3255 W. Armitage Ave., Chicago 47, Ill.
Capacitors

Chemical Rubber Co., 2310 Superior, East, Cleveland 14, Ohio
Laboratory supplies

Chicago Apparatus Co., 1735 No. Ashland Ave., Chicago 22, Ill.
Laboratory supplies

Chicago Dial Indicator Co., 180 N. Wacker Dr., Chicago 6, Ill.
Machinist's dial indicators

Chicago Electronic Engineering Co., 3223 W. Armitage Ave., Chicago 47, Ill.
Transformers

Chicago Industrial Inst. Co., 536 W. Elm St., Chicago 10, Ill.
Radio, electronic & industrial test equipment

Chicago Metal Hose Corp., 1309 S. 3rd Ave., Maywood, Ill.
Metal bellows

Chicago Surgical & Electrical Co., 324 W. Superior St., Chicago 10, Ill.
Laboratory supplies

Chicago Transformer Corp., 3501 W. Addison St., Chicago 18, Ill.
Instrument & power transformers

Cincinnati Clock & Instrument Co., 1113 York St., Cincinnati 14, Ohio
Circuit breaker analyzer

Cincinnati Time Recorder Co., 1733 Central Ave., Cincinnati 14, Ohio
Time recorders

Circle Gauge Co., P. O. Box 2524, Hollywood 28, Calif.
Piston ring gages

Claflin Co., 40 Mathewson St., Providence 3, R. I.
Laboratory supply house

Clapp Instrument Co., Tracy Court, Webster, Mass.
Pressure and vacuum gages

Clare & Co., C. P., 4719 Sunnyside Ave., Jefferson Sta., Chicago, Ill.
Relays, electric counters & electro mechanical specialties

Clark Blast Meter Co., Chas. J., Gladbrook, Iowa
Foundry blast meters & pressure gages

Clark Cooper Co., Palmyra, N. J.
Timers, alarms and controllers

Clark Instrument Co., Inc., 10202 Ford Road, Dearborn, Mich.
Hardness testers

Clark & Sons, Inc., Alvan, 58 Day St., West Somerville, Mass.
Optical & astronomical instruments

Clarke Instrument Corp., 910 Jackson St., Silver Spring, Md.
Eectrical indicating instruments and accessories

Clarkston Corp., 11927 W. Pico Blvd., West Los Angeles, Calif.
Electronic equipment

Clarostat Mfg. Co., Inc., Dover, N. H.
Resistors

Clay-Adams Co., Inc., 141 East 25 St., New York 10, N. Y.
Angle & micro centrifuges, compact balances, analytical weights, microscope slides & cover glasses, glass & porcelain ink, tuning forks

Clebar Watch Co., 551 Fifth Ave., New York 17, N. Y.
Stop watches, timers & chronographs

Cleveland Fuel Equipment Co., 1901 Train Ave., Cleveland, Ohio
Furnace controllers, pyrometers & gages

Clifford Mfg. Co. Div., Standard-Thomson Corp., 564 East First St., Boston 27, Mass.
Metallic bellows & diaphragms; thermostatic assemblies; packless valves

Climax Engineering Co., 15 N. Cincinnati St., Tulsa 1, Okla.
Automatic controllers and regulators, control valves
(See advertisement on pages 33, 34, 35, 36)

Clippard Instrument Laboratory, Inc., 1125 Bank St., Cincinnati 14, Ohio
Electronic apparatus and electrical instruments

Clough-Brengle Co., 6014 Broadway, Chicago 40, Ill.
Electrical instruments, communication testing instruments

Cohn Corp., Sigmund, 44 Gold St., New York, N. Y.
Galvanometer suspension ribbon
(See advertisement on page 121)

Cole Co., H., 82 North High St., Columbus 15, Ohio
Surveying instruments

Cole Instrument Co., 1320 S. Grand Ave., Los Angeles 15, Calif.,
Electrical instruments
(See advertisement on page 22)

Coleman Instrument Co., Inc., 318 Madison St., Maywood, Ill.
Electrical measuring instruments for technical applications

Coleman Instrument & Mfg. Co., 716 Troost Ave., Tulsa 5, Okla.
Oscillographs

Collins Radio Co., Cedar Rapids, Iowa
Eectronic apparatus
(See advertisement on page 2)

Columbia Electric Mfg. Co., 4519 Hamilton Ave., Cleveland 14, Ohio
Rheostats, instruments, shunts, switchboards & special electrical equipment

Combustion Control Corp., 77 Broadway, Cambridge, Mass.
Combustion controls

Commerce Pattern Foundry & Machine Co., 7450 Melville Ave., Detroit 17, Mich.
Balancing machines

Commercial Research Labs., Inc., 20 Bartlett St., Detroit 3, Mich.
Laboratory instruments for automotive, aircraft, railway & allied industries; air flow indicators, direct pressure & piezo-ray engine indicators, fuel flow indicators, magnetic gages, torsional vibration indicators (piezo-ray), recorders (torsiographs & recording instruments for car perfomance & riding comfort.

Communication Measurements Laboratory, 120 Greenwich St., New York 6, N. Y.
Testers, rectifiers, voltage regulators, communication measuring equipment

Comtor Company, 83 Rumford Ave., Waltham 54, Mass.
Precision internal & external comparator-type diameter gages

Conant Laboratories, 6500 O St., Lincoln 5, Neb.
Dry disc rectifiers

Concord Radio Corp., 901 W. Jackson Blvd., Chicago 7, Ill.
Amplifiers

Condenser Products Co., 1369 N. Branch St., Chicago 22, Ill.
Capacitors

Conn, Ltd., C. G., 1101 E. Beardsley Ave., Elkhart, Ind.
Stroboscopes

Connecticut Telephone & Electric Div., Great American Industries, Inc., Meriden, Connecticut
Electronic devices

Connelly Inc., 3154 S. California Ave., Chicago 8, Ill.
Gages & manometers, B T U indicator & H_2S tester

Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa.
Valves, automatic controls
(See advertisement on page 46)

Consolidated Engineering Corp., 620 N. Lake Ave., Pasadena 4, Calif.
Geophysical instruments, mass spectrometers, vibration measuring equipment
(See advertisement on pages 65, 76, 81, 92)

Consulting & Engineering Co., 130 Bradford St., Pittsburgh 5, Pa.
Combustion controllers

Continental Electric Co., Geneva, Ill.
Photoelectric tubes & equipment

Continental Equipment Co., Coraopolis, Pa.
Valves

Control Corporation, 718 Central Ave., Minneapolis 14, Minn.
Automatic & remote control equipment

Control Products, Inc., 306 Sussex St., Harrison, N. J.
Thermostatic switches

Cook Electric Co., 2700 Southport Ave., Chicago 14, Ill., Research Div., 1457 Diversey Pky., Chicago 14, Ill.
Electrical control devices, metal bellows, vapor meters & telephone protective & distributing apparatus, aircraft instrumentation, relays, pressure switches

Cook Research Laboratories, L. H., Box 696, Menlo Park, California
Precision testing instruments for oil industry, oil well cement testing equipment, combustible gas indicators, depth pressure recorders

Coors Porcelain Co., Golden, Colo.
Chemical & scientific porcelain

Corbin Screw Div., American Hardware Corp., New Britain, Conn.
Tachometers & speedometers

Cornell-Dubilier Electric Corp., Hamilton Blvd., So. Plainfield, **New Jersey**
Mica, dykanol, paper & wet & dry electrolytic capacitors

Corning Glass Works, Corning, N. Y.
Technical **glassware**

Counter and Control Corp., 2737 S. 28 St., Milwaukee 7, Wis.
Counters

Cramer Co., Inc., R. W. Centerbrook, Conn.
Interval timers, running time meters, time switches, signal control switches, time delay switches
(See advertisment on page 109)

Crosby Steam Gage & Valve Co., 10 Roland St., Charlestown, Mass.
Safety & relief valves, gages, recorders, testers & steam engine indicators

Crown Industrial Products Co., 1318 W. 69 St., Chicago 36, Ill.

Crystal Research Labs., Inc., 29 Allyn St., Hartford 3, Conn.
Capicators, quartz products, filters, flats, frequency meters, signal generators, mirrors, oscillators, r-f. oscillators, vitreous silica, time interval apparatus, vibration pickups

Curtin & Co., W. H., P. O. Box 118, Houston, Tex.
Laboratory supplies

Curtis Development & Mfg. Co., 1 N. Crawford Ave., Chicago 24, Ill.
Thermostats

Cuthbert Co., Inc., 322 South Third St., Minneapolis 15, Minn.
Scientific grain, seed and food testing equipment

Cutler-Hammer, Inc., 315 North 12th St., Milwaukee 1, Wis.
Electric motor control, safety switches, motor driven valve operators, gas calorimeters, gas mixing & stabilizing control, resistors

Cyclohm Motor Corp., 5-17 46th Rd., Long Island City, N. Y.
Fractional-horsepower motors

Cyclotron Specialties Co., Morago 6, Calif.
Radioactivity equipment

D

Daigger & Co., A., 159 W. Kinzie St., Chicago 10, Ill.
Laboratory supplies

Dale Instruments Div., Electronic Development Co., 4408 N. 23 St., Omaha, Nebr.
Electrical instruments

Daniel Orifice Fitting Co., Houston, Texas
Orifice flowmeters and fittings

Darley & Co., W. S., 2819 Washington Blvd., Chicago 12, Ill.
Pipe locaters

Davidson Mfg. Co., 5142 Alhambra Ave., Los Angeles, Calif.
Astronomical telescopes

Daven Co., 191 Central Ave., Newark 4, N. J.
Attenuators, calibrating equipment for electrical instruments & resistors

Davis Emergency Equipment Co., Inc., Davis Instruments Div., 80 Halleck St., Newark 4, N. J.
Inflammable gas alarms
(See advertisement on page 18)

Davis Regulator Co., 2541 So. Washtenaw Ave., Pilsen Sta., Chicago 8, Ill.
Valves

Dearborn Gage Co., 22038 Beech St., Dearborn, Mich.
Chromium plated gage blocks

Dearborn Scientific Co., 1228 W. Kenzie St., Chicago 22, Ill.
Optical flats

Defender Automatic Inst. & Reg. Co., 815 Clark St., St. Louis, Mo.
Industrial instruments

De Juhasz, K. J., 423 West Park Ave., State College, Pa.
Engine indicators and indicator valves

De Jur-Amsco Corp., Northern Blvd. at 45th St., Long Island City 1, N. Y.
Photoelectric exposure meters, electrical, radio & photographic products

Delmhorst Instrument Co., 115 Cornelia St., Boonton, N. J.
Moisture detectors

Deming Indicator Co., 36 E. 1st. St., Dayton 2, Ohio
Test indicators & dial indicators

Demuth Glass Works, Inc., Wythe Ave. at N. 11th St., Brooklyn 11, N. Y.

Denison Engineering Co., 1160 Dublin Rd., Columbus, Ohio
Presses

Denver Fire Clay Co., P. O. Box 5510, Denver 17, Col.
Specialized industrial control equipment for power plant & processing industries, laboratory specialties

Detect-O-Ray, 2622 N. Halsted St., Chicago 14, Ill.
Photoelectric counters

Detecto Scales, Inc., 540 Park Ave., Brooklyn 5, N. Y.
Scales

Detroit Lubricator Co., 5900 Trumbull Ave., Detroit Mich.
Automatic controls & equipment for air conditioning

Detroit Tap & Tool Co., 8434 Butler St., Detroit 11, Mich.
Machinists' gages

Detroit Testing Machine Co., 9390 Grinnell Ave., Detroit 13, Mich.
Testing machines

Deutschmann Corp., Tobe, Canton, Mass.
Equipment for locating, eliminating, and measuring radio noise; electrolytic, paper dielectric & oil type capacitors

De Vry Corporation, 1111 Armitage Ave., Chicago 14, Ill.
Scientific motion picture equipment & slide projectors

Dial Light Co. of America, Inc., 900 Broadway, New York 3, N. Y.
Dial lights

Dickson Co., 7420 Woodlawn Ave., Chicago 19, Ill.
Furnace controls

Dietert Co., Harry W., 9330 Roselawn Ave., Detroit 4, Mich.
Sand testing equipment; immersion pyrometers, moisture testers, accessories for spectrographic laboratories

Dietzgen Co., Eugene, 2425 Sheffield Ave., Chicago 14, Ill.
Drafting & surveying instruments

Dillon & Co., Inc., W. C., 5410 W. Harrison St., Chicago 44, Ill.
Traction dynamometers, tensile machines, thermometers
(See advertisement on page 99)

Dimco-Gray Co., 207 E. 6 St., Dayton 2, Ohio
Timers and switches

Directional Instruments Corp., 225 Lafayette St., New York 12, N. Y.
Automatic electronic direction finder

Dirigo Compass & Instrument Co., Boeing Field, Seattle 8, Wash.

Distillation Products, Inc., 755 Ridge Road West, Rochester 13, N. Y.
High vacuum pumps, low vapor pressure fluids & auxiliary equipment

DoAll Company, 254 N. Laurel, Des Plaines, Ill.
Gages, Brinnell hardness testers, precision tools

Doelcam Corp., 56 Elmwood St., Newton, Mass.
Precision instruments, gyroscopics, servomechanisms
(See advertisement on page 62)

Doerr Glass Co., Inc., 500 Peach St., Vineland, N. J.
Chemical glassware

Dome Precision Corp., 21 North 11 St., Brooklyn 11, N. Y.
Optical instruments

Dongan Electric Mfg. Co., 2987 Franklin St., Detroit 7, Mich.
Transformers

Doolittle Radio, Inc., 7421 Loomis Blvd., Chicago 36, Ill.
Frequency monitor

Dorr-Patterson Engineering Co., 3362 Wight Ave., Detroit 7, Mich.
Physical testing machines

Douglass Automatic Controls Co., 4505 E. Firestone Blvd., South Gate, Calif.
Boiler controls

Douthitt Corp., 650 W. Baltimore Ave., Detroit 2, Mich.
Process cameras & diaphragm control for cameras

Dow Corning Corp., Midland, Mich.
Silicone fluids and greases for high and low temperature lubrication of instruments, stop-cock grease, high vacuum grease, lens cement, liquid dielectrics, diffusion pump oils

Drafto Co., Cochranton, Pa.
Drafting machines

Drake Manufacturing Co., 1713 W. Hubbard St., Chicago 22, Ill.
Dial & signal lights
(See advertisement on page 76)

Ducommun Co., M., 580 Fifth Ave., New York, N. Y.
Coil-spring stopwatches

Galvanometer Suspension Ribbon

★ **In Gold and Other Metals**

★ **Or In Special Alloys**

Remarkably free from "drift". Made to specified torsional values expressed in dyne-centimeters per radian twist per centimeter length. . . .

FINE WIRE and RIBBON
OF CLOSER-THAN-COMMERCIAL TOLERANCES

CONTROL, WITHIN CLOSE LIMITS OF THE FOLLOWING CHARACTERISTICS: Size; Elongation; Tensile Strength; Torsional Properties; Electrical Resistance; Temperature Coefficient of Resistance; Weight per Unit Length; Purity.

BARE WIRES drawn to .0004" diameter
RIBBON rolled to less than .0001" thick

Write for List of Products

SIGMUND COHN CORP.
44 GOLD ST., NEW YORK
SINCE 1907

Du Mont Labs., Inc., Allen B., Clifton, N. J.
Cathode-ray oscillographs, cathode-ray tubes, associated electronic equipment, television control, studio & transmitting equipment
(See advertisement on page 77)

Duncan Electric Mfg. Co., Lafayette, Ind.
A-c. & d-c. watthour meters, service & switchboard types; portable test meters, appliance meters & instrument transformers

Durant Manufacturing Co., 1914 N. Buffum St., Milwaukee 1, Wis.
Counting & measuring machines

Dusenbery, John, 150 Pine St., Montclair, N. J.
Designers and builders of nautical instruments and special mechanical devices

Dwyer Mfg. Co., F. W., 317 S. Western Ave., Chicago 12, Ill.
Portable & stationary draft gages, CO_2 indicators & combustion testing sets
(See advertisement on pages 56, 66)

Dynamatic Corp., 3307 14th Ave., Kenosha, Wis.
Variable speed drives, torque measuring equipment

Eagle Signal Corp., 202 20th St., Moline, Ill.
Industrial control devices, traffic signal controllers & sign flashers

E

Eastern Industries, Inc., 296 Elm St., New Haven, Conn.
Laboratory pumps, stirrers & thermoregulators

Eastern Science Supply Co., 7-9 High St., Brookline, Mass.
Meteorological instruments

Eastern Specialty Co., 3617 N. 8th St., Philadelphia, Pa.
Testing equipment for checking & maintenance of all types of electricity meters such as watthour meters, demand instruments, etc. Special apparatus for load survey work.

Eastman Kodak Co., 343 State St., Rochester 4, N. Y.
Photographic equipment for laboratories, spectrographic, X-ray, etc.

Eastman Oil Well Survey Co., P. O. Box 408, Long Beach 1, Calif.
Underground surveying equipment

Eaton-Dekeman Co., Mt. Holly Springs, Pa.
Laboratory apparatus

Eberbach & Son Co., Inc., 200 E. Liberty St., Ann Arbor, Mich.
Laboratory apparatus

Eby, Inc., Hugh H., 18 W. Chelten Ave., Philadelphia 44, Pa.
Relays & radio parts

Eck & Krebs, 131 West 24 St., New York 11, N. Y.

Eclipse-Pioneer Div., Bendix Aviation Corp., Bendix, N. J.
Aircraft electrical & mechanical accessories

Eder Instrument Co., 1849 N. Halsted St., Chicago 14, Ill.
Pocket microscope
(See advertisement on page 69)

Edelmann & Co., E., 2332 Logan Blvd., Chicago 47, Ill.
Automotive test instruments

Edin Co., 207 Main St., Worcester, Mass.
Oscillographs and oscilloscopes
(See advertisement on page 77)

Edison, Inc., Thomas A., Instrument Div., West Orange, N. J.
Sealed-in-glass control devices, including thermostatic switches, fire detection thermostats, & timing relays. Hermetically sealed thermostatic valves. Special control equipment
(See advertisement on page 87)

Elcor, Inc., 1501 W. Congress St., Chicago 7, Ill.
Fractional H. P., geared, ungeared, synchronous, capacitor, and D. C. motors

Eltzen Co., Louis C., 17 W. 60th St., New York 23, N. Y.
Extensometers

Electric Auto-Lite Co., Instrument & Gauge Div., Toledo 1, Ohio
Pressure & vacuum gages, speedometers, tachometers & thermometers

Electric Design & Mfg. Co., Burlington, Iowa
Electrical instruments

Electric Eye Equipment Co., Danville, Ill.
Automatic inspection devices

Electric Heat Control Apparatus Co., 507 Fifth Ave., New York 17, N. Y.
Laboratory ovens

Electric Heat Control Co., 9123 Inman Ave., Cleveland 5, Ohio
Internal combustion engine instruments

Electric Hotpack Co. Inc., Melrose St. at Cottman Ave., Philadelphia 35, Pa.
Designers and manufacturers of heat control and laboratory equipment
(See advertisement on page 25)

Electric Indicator Co., 21 Parker Ave., Stamford, Conn.
Synchronous motors, position indicators, level controls, signaling devices

Electric Regulator Corp., 1938 Park Ave., New York 25, N. Y.
Current and frequency regulators

Electric Sorting Machine Co., 410 44 St., S. W., Grand Rapids 8, Mich.
Color analyzers

Electric Speed Indicator Co., 12234 Triskett Road, Cleveland 11, Ohio
Precision electric tachometers & remote position indicators

Electric Tachometer Corp., 2218 Vine St., Philadelphia 3, Pa.
Speed indicators & recorders, electric & mechanical counts

Electrical Facilities Inc., 4224 Holden St., Oakland 8, Calif.
Apparatus for electrical measuring & testing, including precision transformers, watthour meter and instrument transformer testing equipment; rectifier apparatus

Electrical Utilities Co., 2429 St. Vincent Ave., La Salle, Ill.

Electrimatic Div., Simonize Co., Chicago 16, Ill.
Automatic control valves & controls, regulating valves. Pressure, temperature & electrical actuation

Electrocon Corp., 219 Sunrise Highway West, Freeport, N. Y.
Vibration measuring instruments

Electro-Mechanical Instrument Co., 812 Chestnut St., Perkasse, Pa.
Electrical instruments

Electro Mechano Co., 261 E. Erie St., Milwaukee 2, Wis.
Tachometers, precision drill press
(See advertisement on pages 16, 20)

Electro-Medical Laboratory, Inc., Holliston, Mass.
Neurological & Allied medical instruments & general electronic apparatus
(See advertisement on page 29)

Electro Products Laboratories, Inc., 549 West Randolph St., Chicago 6, Ill.
Battery eliminators & rectified A. C. devices
(See advertisement on page 44)

Electro-Tech Equipment Co., 119 Lafayette St., New York 13, N. Y.
Ammeters, voltmeters, power analyzers, bridges
(See advertisement on page 20)

Electronic Associates, Inc., 61 Brighton Ave., Long Branch, N. J.
Aircraft and electrical instruments

Electronic Controls, Inc., 69 Glenwood Place, East Orange, N. J.
Electronic controllers and timers for counting, lighting, etc.

Electronic Development Lab., 2655 W. 19th St., Chicago 8, Ill.
Electronic apparatus

Electronic Mfg. Co., 140 S. Second St., Harrisburg, Pa.
Oscillators, voltmeters

Electronic Products Co., 5330 E. Olympic Blvd., Los Angeles 22, Calif.
Glass instruments & apparatus

Electronic Tube Corp., 1200 E. Mermaid Lane, Philadelphia, Pa.
Cathode ray oscillographs

Electrons, Inc., 127 Sussex Ave., Newark 4, N. J.
Gas-filled & grid-control rectifier tubes

Electyme Motor Products Co., 565 W. Washington St., Chicago 6, Ill.
Clocks and timers

Elematic Equipment Corp., Chicago 21, Ill.
Pyrometers

Elgin National Watch Co., Elgin, Ill., Industrial Products Dev., Aurora, Ill.
Watches, clocks, gages, gaging fixtures and micrometers

Ellison Draft Gage Co., 214 West Kenzie St., Chicago 10, Ill.
Manometers, draft gages, orsats
(See advertisement on page 55)

Eltron Inc., 407 N. Jackson St., Jackson, Mich.

El-Tronics, Inc., 2647 N. Howard St., Philadelphia 33, Pa.
Electrical instruments, nuclear measuring devices

Emerson Apparatus Co., 171 Tremont St., Melrose, Mass.
Calorimeters

Emery Company, A. H., 682 Main St., Stamford, Conn.
Pressure gages and testing machines
(See advertisement on page 97)

Emmett Machine & Mfg. Co., 2249 Fourteenth St. S. W., Akron 14, Ohio
Automatic controllers, timer and control valves

Engel, Inc., H. C. M., P. O. Box 233 1, Sidney, N. Y.
Small drills, small turned parts, millstones in sapphire and block grinding discs

Engelhard, Inc., Charles 900 Passaic Ave., East Newark, N. J.
Industrial instruments

Engineering Laboratories, Inc., 602 E. 4th St., Tulsa 1, Okla.
Seismic exploration equipment, vibration detectors, petroleum engineering devices, signaling equipment

Engineering Research & Development Co., P. O. Box 166, Hinsdale, Ill.
Precision instruments custom built
(See advertisement on page 123)

Engineering Research Associates, Inc., 1902 West Minnehaha Ave., St. Paul 4, Minn.

Engineers Specialty Div., 980 Ellicott St., Buffalo 8, N. Y.
Optical comparators

Eppley Laboratory Inc., 12 Sheffield Ave., Newport, R. I.
Thermopiles, pyrheliometers & standard cells for both industrial & laboratory use
(See advertisement on pages Inside Front Cover and 29)

Equipoise Controls, 100 Stevens Ave., Mount Vernon, N. Y.
Thermometers and tachometers

Erickson Specialty Co., 10 Cayuga St., Cohoes, N. Y.
Solenoid valves

Erie Resistor Corp., 644 West 12th St., Erie, Pa.
High frequency & molded resistors

E & S Optical Co., 911 Willow Ave., Hoboken, N. J.
Optical components
(See advertisement on page 73)

Ess Instrument Co., 96 S. Washington Ave., Bergenfield, N. J.
Industrial electronic instruments, photoelectric for smoke, flame, turbidity, color. Specific gravity indicators, recorders and controllers

Esterline-Angus Co., Inc., P. O. Box 596, Indianapolis 6, Ind.
Graphic recording & contract-making electrical instruments, time, speed, condensate purity, pressure & vacuum recorders, telemeters & portable current transformers

Eureka X-Ray Tube Corp., 3240 N. Kilpatrick Ave., Chicago, Ill.
X-ray tubes

Ever Ready Thermometer Co., 1118 Bedford Ave., New York, N. Y.
Calorimeters, thermometers

Everson Mfg. Co., 214 W. Huron St., Chicago 10, Ill.
Chemical feeders

Exact Weight Scale Co., 944 West 5th Ave., Columbus 8, Ohio
Over-and-under weight scales & indicators for industrial purposes

F

Fairbanks, Morse & Co., 600 So. Michigan Ave., Chicago 5, Ill.
Scales

Fairchild Camera & Inst. Co., 88-06 Van Wyck Blvd., Jamaica 1, N. Y.
Instrument motors, servo-motors,, navigational instruments, oscilloscope- and X-ray recording cameras.

Falstrom Co., 147 Falstrom Ct., Passaic, N. J.
Steel instrument panels, panel board assemblies, cubicles, totally enclosed weather & vermin proof instrument enclosures & steel cabinets.
(See advertisement on page 4)

Farnsworth Television & Radio, Fort Wayne, Ind.
Industrial television systems

Farrand Optical Co., Inc., Bronx Blvd. and E. 238 St., New York 66, N. Y.
Scientific instruments

Farrel-Birmingham Co., Inc., 25 Main St., Ansonia, Conn.
Calipers for checking roll diameters & gear tooth comparators

— ERDCo —

PRECISION INSTRUMENTS

For Industry and Laboratory

Typical examples are:

Subminiature Amplifiers
Indicators and controls
Tachometers — electrical, with or without contact with machine
Pressure Transducers
Photoelectric Controls
Machinery Analysis Stethoscope
Engine and Vehicle Test Equipment
Custom Built Indicating and Control Devices

QUALITY

Write for Information.

ENGINEERING RESEARCH AND DEVELOPMENT CO.
Box 166 Hinsdale, Ill.

Farris Engineering Corp., 436 Commercial Ave., Palisades Park, N. J.
Safety and relief valves; naval and aircraft regulators; and hydraulic remote controls
(See advertisement on page 113)

Fassett Co., Inc., C. M., W. 21 Main Ave., Spokane 8, Wash.
Laboratory supplies

Fast & Co., John E., 3105 N. Crawford St., Chicago 41, Ill.
Capacitors

Fecker, J. W., 2016 Jerrysville Ave., Pittsburgh 14, Pa.
Astronomical instruments

Federal Anti- Capacity Switch Corp., 1200 Niagara St., Buffalo, N. Y.
Anti-capacity switches

Federal Instrument Co., 14-02 Broadway, Long Island City 2,N.Y.
Resistors

Federal Mfg. & Eng. Corp., 211 Steuben St., Brooklyn 5, N. Y.
Microscopes

Federal Classifier Systems, Inc., 127 N. Dearborn St., Chicago 2, Ill.
Particle size classifiers

Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Precision measuring instruments
(See advertisement on page 54)

Federal Telephone and Radio Corp., 100 Kingsland Road, Clifton, N. J.
Radio transmitting and direction finding equipment, transmitting tubes, field intensity meters

Feiler Engineering Co., 945 George St., Chicago 14, Ill.
Electrical Instruments
(See advertisement on page 74)

Fellows Gear Shaper Co., Springfield, Vt.
Gear checking machines & involute measuring machines

Fenwal, Inc., 3 Main St., Ashland, Mass.
Industrial thermostats

Ferguson Co., 814 Ridgely St., Baltimore 30, Md.
Laboratory supply house

Ferner Co., R. Y., 110 Pleasant St., Malden, Mass.
Precision instruments

Ferranti Electric, Inc., 30 Rockefeller Plaza, New York 20, N. Y.
Electrical instruments

Ferris Instrument Corp., Boonton, N. J.
Laboratory & production testing equipment, radio noise & field strength meters & special electrical instruments

Fidelity Machine Co., 3906 Frankfort Ave., Philadelphia, Pa.
Abrasion testers

Field Electrical Instrument Co., 2432 Grand Concourse, New York, N. Y.
Electrical instruments

Fischer & Porter Co., 37 County Line Road, Hatboro, Pa.
Rotameters, sight flow meters, automatic flow controllers, precision optical cells, precision bore glass tubing & special precision glass apparatus.

Fish-Schurman Corp., 230 East 45 St., New York 17, N. Y.
Scientific instruments, optical, technical & scientific glass & porcelain
(See advertisement on page 16)

Fisher Governor Co., Marshalltown, Iowa
Motor control valves & regulators

Fisher-Pierce Co., 70 Ceylon St., Boston 21, Mass.
Photoelectric controls, relays, timers

Fisher Research Laboratory, Box 640, Palo Alto, Calif.
Leak detector & pipe finder. Electronic equipment

Fisher Scientific Co., 711 Forbes St., Pittsburgh 19, Pa.
Standard & special equipment & instruments for chemical, biological & metallurgical laboratories

Flader, Inc., Fredric, 583 Division St., North Tonawanda, N. Y.
Aircraft Instruments
(See advertisement on page 88)

Feischauer & Son, F., 89-36 187 Place, Hollis, L. I., N. Y.
Instrument makers

Flight Research Engineering Corp., P. O. Box 1-F, Richmond 1, Va.
Servomechanisms and automatic control systems
(See advertisement on pages 23, 91)

Fonda Gage Co., 53 Daly St., Stamford, Conn.
Gage blocks

Ford Engineering Co., Box 163, Los Angeles 41, Calif.
Voltage dividers

Ford Regulator Valve Co., 403 Broome St., New York 13, N. Y.
Regulating valves

Foster Engineering Co., 835 Lehigh Ave., Union, N. J.
Control valves

Foxboro Co., 46 Neponset Ave., Foxboro, Mass.
Indicating, recording & controlling instruments for pressure, temperature, humidity, level & flow
(See advertisement on page 15)

Fraser Development Laboratory, 122 Cutter Mill Road, Great Neck, N. Y.
Fluxometer for measuring magnetic flux in gauss

Freas Glass Works, Francis L., 146 E. 9th St., Conshohocken, Pa.
Hydrometers, thermometers & glass instruments

Fredericks Co., George E., Bethayes, Pa.
Glass instruments & apparatus

Freed Transformer Company, 1718 Weirfield St., Brooklyn 27, N. Y.
Transformers

Frick Co., Inc., Waynesboro, Pa.
Float valve controls & electric controls, refrigerating & air conditioning machinery

Friez Instrument Div., Bendix Aviation Corp., Baltimore 4, Md.
Temperature & humidity controls, gas & stoker controls, damper motors, electrical relays, temperature & humidity indicators & recorders, psychrometers, draft gages, anemometers, CO_2 analyzers

Fuess, Inc., R., 39 West 60th St., New York 23, N. Y.
Scientific instruments

Fuel Watchman, 77-29 138 St., Flushing, L. I., N. Y.

Fulcrum Oil Company, Franklin, Pa.
Instrument oils
(See advertisement on page 65)

Fuller Co., 110 Bridge St., Catasauqua, Pa.
Bulk material level controllers

Futon Sylphon Div., Robertshaw-Fulton Controls Co., Knoxville 4, Tenn.
Temperature & pressure regulators, sylphon bellows; thermostat assemblies; diesel controls; automobile thermostats; air conditioning controls

Furnas Electric Co., 300 McKee St., Batavia, Ill.
Pressure controls

Furst Electronics, 12 S. Jefferson St., Chicago 6, Ill.
Electronic instruments

G

Gaertner Scientific Corp., 1201 Wrightwood Ave., Chicago 14, Ill.
Measuring instruments including toolmaker microscopes, micrometer slides, micrometer microscopes, comparators, interferometers, spherometers, microscopes & telescopes for observation & inspection; time recording devices including chronographs & special devices; dividing machines for engraving linear & circular scales; goniometers; spectroscopic equipment & accessories
(See advertisement on page 124)

Gallien, R. P., 220 W. 5 St., Los Angeles 13, Calif.
Instrument lathes & tools

Gardner Laboratory, Inc., Henry A., 4723 Elm St., Bethesda 14, Md.
Scientific instruments, automatic inspection devices

Gas Appliance Specialties Co., 57th St., bet. Northern Blvd. & 32nd Ave., Woodside, New York, N. Y.
Gas regulators

Gates & Co., Geo. W., Franklin Sq., Long Island City, N. Y.
Light sources & etching compounds for glass & quarts

Gauthier, Donat A., 7408 Poe Ave., Detroit 6, Mich.
Gasoline measuring devices & automobile service station testers

Geier & Bluhm, Inc., 607 River St., Troy, N. Y.
Mechanical devices & spirit level vials
(See advertisement on page 65)

Gelber, Samuel S., 441 Plymouth Ct., Chicago 6, Ill.
Balancing machines

Genales, Andrew, 29 Second Ave., Nyack, N. Y.
Toolroom test indicators

General Biological Supply House, Inc., 761 East 69th Pl., Chicago 37, Ill.
Biological laboratory supplies

General Cement Mfg. Co., 919 Taylor Ave., Rockford, Ill.
Switches, cement tester, and spark plug tester

General Control Co., 1200 Soldiers Field Rd., Boston 34, Mass.
Electrical switches

General Controls Co., 801 Allen Ave., Glendale 1, Calif.
Pressure, temperature & flow control valves
(See advertisement on page 37)

General Electric Co., 1 River Rd., Schenectady 5, N. Y.
Electrical instruments & meters
(See advertisement on page 11)

General Electric Co., 1285 Boston Ave., Bridgeport 2, Conn.
Rectifiers & switches

General Electric Co., Chemical Dept., 1 Plastics Ave., Pittsfield, Mass.
Magnets and instrument oils

General Electric Co., Electronic Div., 1001 Wolf St., Syracuse, N. Y.
Electronic equipment

General Electric Co., Lamp Dept., Nela Park, Cleveland 12, Ohio
Lighting sources

General Electric X-Ray Corp., 4855 W. McGeoch Ave., Milwaukee 14, Wis.
Medical, dental & industrial X-ray apparatus, accessories & supplies

General Physical Laboratory, 509 Fifth Ave., New York 17, N. Y.
Special light sources

General Power Plant Corp., 381 Fourth Ave., New York 16, N. Y.
Furnace controls

General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Radio & electrical measuring instruments for laboratory & industrial use; stroboscopes noise measuring equipment, measuring & test equipment for electrical communication systems

General Regulator Corp., 165 Broadway, New York 6, N. Y.
Combustion, draft, liquid level & pressure controls

General Scientific Corp., 4829 So. Kedzie Ave., Chicago 32, Ill.
Lenses & photoelectric cells

General Test Equipment Co., 38 Argyle Park, Buffalo 9, N. Y.
Pen size radio signal source, also special apparatus

Geophysical Instrument Co., Key Blvd. & Nash St., Arlington, Va.
Instruments & accessories for prospecting for oil, minerals, water, bedrock; also equipment for making measurements in wells, radioactivity instruments

Geotechnical Corp., 3712 Haggar Drive, Dallas, Texas
Geophysical instruments

Gaertner

MEASURING INSTRUMENTS
Cathetometers
Creep Test Instruments
Comparators
Micrometer Microscopes
Micrometer Slides
Standard Scales
Toolmaker Microscopes

DIVIDING MACHINES
Circular
Linear
Manual
Automatic

INTERFEROMETERS
Michelson
Fabry Perot
Thermal Expansion

POLARIZING APPARATUS
Compensators
Polarimeters
Polariscopes

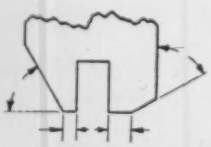
OPTICAL TEST INSTRUMENTS
Optical Benches
Spherometers
Spectrometers
Microscopes
Telescopes
Refractometers

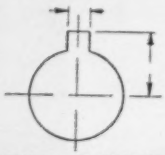
SPECTROGRAPHS
Infrared
Quartz
Raman
Spectroscopes
Monochromators

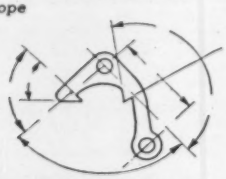
PHOTOMETERS
Martens
Spectrophotometers
Microdensitometers

MISCELLANEOUS
Chronographs
Laboratory Supports
Precision Ruling

Applications of the Toolmakers Microscope







THE GAERTNER SCIENTIFIC CORP.
1208 Wrightwood Ave. : Chicago 14 : U.S.A.

G. & G. Precision Works, Inc., 5-33 Forty-eighth Ave., Long Island City 1, N. Y.
Mechanical optical & electrical precision instruments

Giannini & Co., G. M., 285 West Colorado St., Pasadena 1, Calif.
Aircraft instruments
(See advertisement on page 45)

Gilman Scientific Instrument Co., 1356 N. Hill Ave., Pasadena 7, Calif.
Seismographs

Gilmore, E. R., Box 5718, Homewood Sta., Pittsburgh 8, Pa.
Gas leak stethoscopes

Gisholt Machine Co., Madison 3, Wis.
Static & dynamic balancing machines

Glass Engineering Laboratories, 601 O'Neill Ave., Belmont, Calif.
Laboratory apparatus; ultra-speed centrifuges

Gleason-Avery, Inc., Auburn, N. Y.
Furnace controls

Globe Industries, Inc., 125 Sunrise Place, Dayton, O.
Aircraft instrument testing equipment, aircraft interval timing istruments, aircraft photo equipment, automatic control instruments

Globe Phone Mfg. Corp., Reading, Mass.
Pipe locating equipment, leaky valve locators, hearing aids, secret phone or listening equipment for government investigating agencies

Globe Tool & Engg. Co., 410 Davis Ave., Dayton 3, Ohio
Dynamic balancing equipment

Glogau & Co., Inc., 1912 W. Birchwood, Chicago 26, Ill.
Calipers

G-M Laboratories, Inc., 4326 N. Knox, Chicago 41, Ill.
Galvanometers and galvanometer relays

G. M. Manufacturing Co., 50 West 3 St., New York, N. Y.
Thermometers, hydrometers, psychrometers, hygrometers

Goerz, American Optical Co., C. P., 317 East 34th St., New York 16, N. Y.
Photographic lenses, optical prisms & flats, and other optical units to specification

Goetze Niemer Co., 808 Francis St., St. Joseph 1, Mo.
Laboratory supply house

Gogan Machine Corp., 1440 E. 55 St., Cleveland 3, Ohio
Automatic hardness testers

Goldak Co., 1544 W. Glenoaks Blvd., Glendale 1, Calif.
Surveying instruments, pipe locators, leak detectors

Goodrich Co., B. F., 450 South Main St., Akron, Ohio
Vibration absorbers

Gordon Co., Claud C., 3000 S. Wallace St., Chicago 16, Ill.
Pyrometers, metallurgical testing machines, thermocouples, thermocouple wire, lead wire, insulators

Gorrell & Gorrell, Haworth, N. J.
Equipment for biological & psychological work

Gotham Instrument Co., 149 Wooster St., New York 12, N. Y.
Indicating dial & recording thermometers

Gotham Scientific Co., 106 Water St., New York 5, N. Y.
Laboratory supplies

Gow-Mac Instrument Co., 22 Lawrence St., Newark 5, N. J.
Thermal conductivity gas analyzers & gas analysis cells
(See advertisement on page 21)

Graflex Corp., 154 Claressa St., Rochester, N. Y.
Scientific cameras

Graham-Mintel Instrument Co., 2443 Prospect Ave., Cleveland 15, Ohio
Precision measuring instruments

Gray Instrument Co., 64½ W. Johnson St., Philadelphia 44, Pa.
Scientific instruments

Grayhill, Inc., 1 N. Pulaski Rd., Chicago, Ill.
Switches

Green, Henry J., 1191 Bedford Ave., Brooklyn 16, N. Y.
Meteorological instruments

Greene Bros., Inc., 1810 Griffin St., Dallas 2, Texas
Laboratory supplies

Greenfield Tap & Die Corp., Greenfield, Mass.
Machine shop gages

Greiner, Inc., Emil, 20-26 N. Moore St., New York 13, N. Y.
Laboratory supplies

Griebel Co., E., 8 Wayne St., Carbondale, Pa.
Thermometers, hydrometers, chemical & laboratory glassware

Griner Co., A. J., 417 East 13th St., Kansas City, Mo.
Laboratory supplies

Griswold Mfg. Co., F. T., Lancaster Ave., Wayne, Pa.

Grove Regulator Co., 1190 67th St., Oakland 8, Calif.
Pump governors, pressure reducing & back pressure regulators for gas or liquid pressures to 6000 lbs.

Guardian Electric Mfg. Co., 1621 W. Walnut St., Chicago 12, Ill.
A-c and d-c relays

Gubelman Publishing Co., 2-8 Garden St., Newark 5, N. J.
(See advertisement on page 12)

Gump Co., B. F., 435 Clinton St., Chicago 7, Ill.
Scales

Gurley, W. & L. E., 514 Fulton St., Troy, N. Y.
Surveying & allied engineering instruments, paper testing & aeronautical navigation instruments & standard weights & measures

Gustafson Mfg. Co., G. D., 4855 N. Paulina St., Chicago 40, Ill.
Instrument tools
(See advertisement on page 116)

H

Hagan Corp., Hagan Bldg., Pittsburgh 30, Pa.
Combustion control equipment; flow meters, draft & pressure gages for law pressure gas & air measurements; recording, indicating & integrating in any combination
(See advertisement on page 7)

Halliburton Oil Well Cementing Co., Duncan, Okla.
Oil well surveying instruments

Hamilton Mfg. Co., Two Rivers, Wis.
Laboratory furniture

Hamilton Watch Co., Lancaster, Pa.
Chronometers & watches

Hammel-Dahl Co., 243 Richmond St., Providence, R. I.
Automatic control valves
(See advertisement on Inside Back Cover)

Hand & Sons Co., John E., Atlantic & Washington Aves., Haddonfield, N. J.
Navigational instruments

Hanovia Chemical & Mfg. Co., 90 Chestnut St., Newark 5, N. J.
Quartz mercury arc lamps

Hankison Corporation, 1501 Beaver Ave., Pittsburgh 12, Pa.
Filter for instrument air

Hansen Co., Wm., 165 Silverbrook Ave., Niles, Mich.
Timers and clocks

Hardwick, Hindle, Inc., 40 Herman St., Newark 5, N. J.
Resistors

Hart Mfg. Co., R. E., 416 Ward Bldg., Battle Creek, Mich.
Production counters

Hart Moisture Gauges, see Kaydel Moisture Gauges

Hart Moisture Meters, Grand Central Terminal, New York, N. Y.
Moisture testers

Harvey Radio Laboratories, Inc., 447 Concord Ave., Cambridge, Mass.
Electronic apparatus

Harvey-Wells Electronics, Inc. Southbridge, Mass.
Aircraft navigational instruments

Hasler-Tel Co., 30 Vesey St., New York 7, N. Y.
Speed indicators, portable, chronometric

Hastings Instrument Co., P. O. Box 1275, Hampton, Va.
Consulting instrument engineers, special developments

Hathaway Instrument Co., 1315 S. Clarkson St., Denver 10, Colo.
Instruments & apparatus for electrical & mechanical measurements & control

Hawk Ecol & Engineering Co., 7663 Epworth Blvd., Detroit 4, Mich.
Controllers & testing devices

Haydon Co., A. W., 111 W. Main St., Waterbury 32, Conn.
Relays and timers

Hayden Manufacturing Co., Torrington, Conn.
Synchronous Motors, automatic timers
(See advertisement on pages 106, 107)

Hayes Scientific Appliances, 202 N. Broadway, Urbana, Ill.
Scientific instruments

Hays Corp., P. O. Box 299, Michigan City, Ind.
Combustion instruments & automatic combustion controls
(See advertisement on pages 37, 46, 59, 60)

H-B Instrument Co., Inc., 2633 Trenton Ave. Philadelphia 25, Pa.
Thermometers & hydrometers, remote control equipment
(See advertisement on page 13)

HD Electric Co., 219 N. Aberdeen, Chicago 7, Ill.
Split core ammeters, demand meters

Hebler Co., W. O., Central at Long Ave., Hillside, N. J.
Electrical gas analyzers

Heil Chemical & Mfg. Co., 218 S. 4 St., St. Louis 2, Mo.
Laboratory supplies

Heiland Research Corp., 130 E. 5th Ave., Denver 9, Colo.
Geophysical instruments, photoflash synchronizers, gas detectors, oscillographs, strain gages, vibration detectors, recording cameras & industrial instruments.
(See advertisement on page 75)

Heise Bourdon Tube Co., Brook Rd., Newton, Conn.
Bourdon tube devices
(See advertisement on page 52)

Helicoid see American Chain & Cable Co.

Helipot Corp., 1011 Mission St., South Pasadena 8, Calif.
Rheostats, voltage dividing resistors

Heinrich Co., Carl, 677 Beacon St., Boston, Mass.
Astronomical instruments

Heller Co., George K., 1540 Ridgely St., Baltimore 30, Md.
Manual motor controls

Hellige, Inc., 3718 Northern Blvd., Long Island City, N. Y.
Scientific instruments, laboratory & bacteriological supplies
(See advertisement on page 110)

Henderson & Co., H. B., East Liverpool, Ohio
Pyrometric cones

Henry Valve Co., Inc., 3215 W. North Ave., Melrose Park, Ill.
Control valves

Henschel & Co., Inc., John, 105 E. 29th St. New York 16, N. Y.
Drawing instruments

Henson Co., Fred C., 3311 E. Colorado St. Pasadena, Calif.
Electroscope

Hersey Co., Watertown, Wis.
Feed water meters, flow indicators continuous blowdown, heat exchangers and boiler feed regulators. Also meters and flow indicators for corrosive chemicals.

Herbach & Rademan, Inc., 522 Market St., Philadelphia 6, Pa.
Electronic instruments

Herman Stone Co., 324 Harries Bldg., Dayton 2, Ohio
Precision granite surface plates

Herron Optical Co., 705 W. Jefferson Blvd. Los Angeles 7, Calif.
Lenses, mirrors and optical parts

Hetherington & Berner, 701 Kentucky Ave., Indianapolis 7, Ind.
Fluidometers

Hetherington & Son., Inc., Robert, P. O. Box 204, Sharon Hill Pa.
Switches

Heusser Instrument Mfg. Co., 1388 S. State St., Salt Lake City 1, Utah
Analytical balances

Hevi Duty Electric Co., Milwaukee 1, Wis.
Electric furnaces

Hewlett-Packard Co., 395 Page Mill Road, Palo Alto, California
Electronic equipment

Hexacon Electric Co., 159 W. Clay Ave., Roselle Park N. J.
Electric soldering irons

Heyman Mfg. Co., 530 Michigan Ave., Kenilworth N. J.
Inspection instruments

H & H Thermostats, Inc., 682 Broadway, New York 12, N. Y.
Altimeters, recording thermometers, recorder ink for extreme temperatures

Hickok Electric Instrument Co., 10514 Dupont Ave., Cleveland 8, Ohio
Electric indicating instruments

Hiergesell & Sons, Wm., 295 Pearl St., New York 7, N. Y.
Thermometers & hydrometers

High Voltage Engineering Corp., 7 University Road Cambridge, Mass.
High voltage devices

Hillyer Instrument Co., Inc., 54-60 Lafayette St., New York 13, N. Y.
Computers and inspection devices

Hoke, Inc., 148 S. Dean St., Englewood, N. J.
Regulators

Holtzer-Cabot Electric Co. 125 Amory St., Boston 19, Mass.
Fractional Horsepower Motors

Hopp Press, Inc., 460 W. 34 St., New York 1, N. Y
Nameplates, dial faces, scales, instruction plates

Houston Technical Laboratory, 2218 Branard St., Houston 6, Texas
Gravity meters for geophysical prospecting

Howe & French Inc., 99 Broad St., Boston 10, Mass.
Laboratory supplies

Howe Scale Co., Rutland, Vt.
Scales

Howland Optical Co., 29 Cottage Place, Nutley, N. J.
Optical flats lenses, magnifiers

Hull Mfg. Co., P. O. Box 246, Warren Ohio
Compasses

Humboldt Mfg. Co., 2014 N. Whipple St., Chicago 47, Ill.
Cement & concrete testers

Huppert Co., K. H., 6830 Cottage Grove Ave., Chicago, Ill.
Laboratory furnaces

Hydraulic Div., New York Air Brake Co. 420 Lexington Ave., New York, N. Y.
Hydraulic control systems

Hydraulic Equipment Co., 1104 E. 222 St., Cleveland 17, Ohio
Gage testers

Hytron Radio & Electronics Corp., 76 Lafayette St., Salem, Mass.
Electronic tubes

I

Ideal Industries, Inc., 1420 Park Ave., Sycamore, Ill.
Insulation testers & revolution counters

Ideal Laboratory Tool & Supply Co., P. O. Box 891, Cheyenne, Wyo.
Aircraft instrument test apparatus, sensitive needle valves
(See advertisement on page 19)

Illinois Testing Laboratories, Inc., 420 N. LaSalle St., Chicago 10, Ill.
Indicating pyrometers, resistance thermometers pyrometer controllers air velocity meters, metal detectors
(See advertisement on pages 8, 9)

Impact Register Co., 510 N. Neil St., Champaign, Ill. Ill.
Instruments for determining and recording impacts received by railroad cars and riding qualities of railroad cars, automobiles

Indiana Steel Products Co., 6 N. Michigan Ave., Chicago 2, Ill.
Instrument magnets

Industrial Condenser Corp., 3243 N. California Ave., Chicago 18, Ill.
Oil paper & electrolytic capacitors

Industrial Electronics, Inc., 21 Henry St., Detroit 1, Mich.
Cathode-ray oscillograph

Industrial Engineering Corp., Rea Bldg., Terre Haute, Ind.
Relays

Industrial Filter & Pump Mfg. Co., 1621 Carroll Ave., Chicago 12, Ill.
Salt spray testers

Industrial Instruments, Inc., 17 Pollock Ave., Jersey City 5, N. J.
Electrical measuring & test equipment
(See advertisement on page 69)

Industrial Pyrometer & Supply Co., Alton, Ill.
Thermocouples

Industrial Scientific, Inc., 317 Nagle St., Houston 1, Texas
Laboratory supply house

Industrial-Scientific Supply Co., 1014 Taylor St., Fort Worth 1, Texas
Laboratory supplies

Industrial Timer Corp. 117 Edison Place, Newark 5, N. J.
Industrial timers, motor driven, with automatic reset. Controllers, signals, testing equipment for electrical parts (operation or life test)

Industrol Corp., 88-35 76th Ave., Glendale, L. I. 27, N. Y.
Cycle controllers, instrument panels and air dryers
(See advertisement on page 108)

Inferno Co., Box 1138 Shreveport 90, La.
Combustion instruments

Instron Engineering Corp., 2, Hancock St., Quincy 71, Mass.
Testing machines

Instrumaster Industries, Inc., 2160 W. Jackson Blvd., Chicago 12, Ill.
Drawing instruments

Instrument Development Labs., Inc. 541 Willis Ave., Williston Park, L. I., N. Y.
Photoelectric color analyzers

Instrument Electronics, 253-21 Northern Blvd., Little Neck, L. I., N. Y.
Electronic instruments

Instrument Laboratories, 315 W. Walton Place, Chicago 10, Ill.
Electrical testing sets

Instrument Laboratory Inc. P. O. Box 4098, Interbay Station, Seattle 99, Washington
Counting & indicating instruments

Instrument Repair & Mfg. Co., 1258-18th Ave., Oakland 1, Calif.
Diaphragm valves and controllers

Instrument Resistors Co., 1036 Commerce Ave., Union, N. J.
Instrument resistors

Instruments Corp., 4 N. Central Ave., Baltimore 2 Md.
Meteorological instruments

International Business Machines Corp., 590 Madison Ave., New York 22, N. Y.
Scales & time instruments

International Equipment Co., 1284 Soldiers Field Road, Brighton, Boston 35, Mass.
Analytical centrifuges

International Instruments, Inc. 331 East St., New Haven 11, Conn.
Electrical instruments

International Rectifier Corp., 6809 S. Victoria Ave., Los Angeles 43, Calif.
Photoelectric cells and dry disc rectifiers
(See advertisement on page 28)

International Register Co., 2620 W. Wash. Blvd., Chicago 12, Ill.
Coin meters—timers for electric ranges & gas ovens

International Resistance Co., 401 N. Broad St., Philadelphia 8 Pa.
Metallized & wirewound fixed & variable resistors including high voltage & high frequency types

Islep Radio Mfg. Corp., Foot of Beech St., Islep, N. Y.
Amplifiers

Ithaca Scientific Instrument Co., Ithaca, N. Y.
Drawing instruments

J

Jackson Electrical Instrument Co., 18 S. Patterson Blvd., Dayton 1, Ohio
Radio testing equipment

Jacobs Instruments, 4718 Bethesda Ave., Bethesda 14 Md.
Ballistic instruments

Jaeger Watch Co., Inc., 304 East 45th St., New York 17, N. Y.
Automobile clocks, timepieces for aviation and marine, chronomatic tachometers & true airspeed indicators

Jansson Gage Co., 19206 Glendale Ave. Detroit 23, Mich.
Gages; gage blocks—special, built up; flush pin and thread gages, carboloy or steel

Jardur Import Co., 875 Broadway, New York 3, N. Y.
Chronographs & stop-watches

Jarrell-Ash Co., 165 Newbury St., Boston 16, Mass.
Representatives for Adam Hilger, Ltd., manufacturers of optical instruments
(See advertisement on page 72)

J B L Instrument Co., Sycamore & Mill Rd. Clifton Heights, Pa.
Rotary instrument switches, transformer tapping, railway signal gear, decade resistance boxes

J-B-T Instruments, Inc., 443 Chapel St., New Haven 8, Conn.
Electrical measuring & controlling instruments: pyrometers, thermocouples selector switches, potentiometers, resistance thermometers, laboratory instruments
See advertisement on pages 22, 126)

Jeffrey Mfg. Co., Columbus 16, Ohio
Weighing, feeding, batching & proportioning equipment

Jenckes Knitting Machine Co., 180 Weeden St., Pawtucket, R. I
Profile and thickness gages

Jenkins Bros. 80 White St., New York 13, N. Y.
Regulating valves

Jerguson Gage & Valve Co., 87 Fellsway, Somerville 45, Mass.
Precision gages & valves
(See advertisement on page 52)

Johnson Co., E. F., Gothard Div., Waseca, Minn
Connectors, plugs, dial lights, etc.

Johnson Gage Co. 534 Cottage Grove Rd., Bloomfield, Conn.
Comparators & gages

Johnson Service Co., 507 E. Michigan St., Milwaukee 2, Wisc.
Automatic temperature & humidity control for heating, cooling, ventilating, air conditioning & industrial processes

Johnson-Williams, Ltd., Box 8, Palo Alto, Calif.
Combustible gas indicators & alarm systems, portable & continuous, including accessories
(See advertisement on page 58)

Johnston & Jennings Company, 877 Addison Rd., Cleveland 14, Ohio
Depth gages, valves

Jones, Howard B. Div., Cinch Mfg. Co., 2460 W. George St., Chicago 18, Ill.
Connectors

Jones Electronics Co., M C., 96 N. Main St., Bristol, Conn.
Standing wave meter

Jones & Lamson Machine Co., Clinton & Whitmore Sts., Springfield, Vt.
Optical comparators

Jones-Motrola Corp. 432 Fairfield Ave., Stamford, Conn.
Tachometers, speed indicators & speedometers

Jones Optical Works, A. D., 2400 Massachusetts Ave., Cambridge, Mass
Lenses, light filters and optical parts

K

Kaydel Moisture Gauges, 126 Liberty St., New York 6, N. Y.
Moisture meters
(See advertisement on page 69)

Kahl Scientific Instrument Co., Inc., El Cajon, Calif.
Thermometer, hydrometer, psychrometers, hygrometers

Kalbfell Laboratories, Inc., 1076 Morena Blvd., San Diego 10, Calif.
Audio frequency equipment, bridges, capacitance meters

Kansas City Laboratory Supply Co., 1434 Wyandotte St., Kansas City 6 Mo.
Laboratory supplies

Karp Metal Products Co., Inc., 120 30th St, Brooklyn 32, N. Y.
Instrument panels

Kauffman-Lattimer Co., 263 N. Front St., Columbus 16, Ohio
Laboratory supplies

Keckley Mfg. Co., 400 W. Madison St., Chicago 6 Ill
Steam and liquid control equipment

Keithley Instruments, 1507 Warrensville Center Road, Cleveland 21, Ohio
Amplifiers

Kelley-Koett Mfg. Co., Inc., Covington, Ky.
X-Ray apparatus
(See advertisement on page 84)

Kellogg Switchboard & Supply Co., 6650 S. Cicero, Chicago 38 Ill.
Relays

Kendall, James W., 13 Miantonomi Ave., Newport, R. I.
Photoelectric cells

Kent Cliff Laboratories, 921 East 12 St., Brooklyn, N. Y.
Hardness testers

Kenyon Instrument Co., Inc., 1345 New York Ave. Huntington, L. I., N. Y
Airport & marine instruments

Kepco Laboratories, 149-14 41st Ave., Flushing, L. I., N. Y.
Radio test panels

Kessler Co., Walter H., 97 Reade St. New York, N Y.
Thermometers and hydrometers

Kester Solder Co., 4201 Wrightwood Ave., Chicago 39, Ill.
Cored solders

Keuffel & Esser Co., Adams & Third Sts., Hoboken, N. J.
Surveying instruments

Kewaunee Mfg. Co., End of So. Center St., Adrian Mich.
Laboratory furniture

Keystone Carbon Co., Inc., Saint Marys, Pa.
Carbon resistors

K and H Industrial Products, Inc., 459 Morgan Ave., Akron 11, Ohio
Instrument panel boards

Kieley & Mueller Inc., 2013-2033—43 St. North Bergen, N. J.
Pressure regulating & flow control devices

Kimble Glass Co., Vineland, N. J.
Glass apparatus, glass tubing, thermometers, hydrometers

King, Andrew, 519 Broad Acres Road, Narberth Pa.
Portable Brinell hardness tester

King Engineering Corporation, 942 Gordon Ave., Ann Arbor, Mich.
Liquid level indicators, distant reading
(See advertisement on page 56, 66)

Kirk & Blum Manufacturing Co., 2838 Spring Grove Ave., Cincinnati 25, Ohio
Instrument panels and sheet metal assemblies

Klett Mfg. Co. 179 E. 87th St., New York 28, N. Y.
Colorimeters

Klipfel Mfg. Co., 1000 Weller Ave., Hamilton, Ohio
Regulating valves

Knights Company, James, Sandwich, Ill.
Crystals

Knopf Instrument Co., 250 Culver Ave., Jersey City, N. J.
Counters and vehicle instruments

Koch & Co., F. A. 72 Spring St. New York 12, N. Y.
Laboratory supplies

Koehler Instrument Co., 168-56 Douglas Ave., Jamaica 3, N. Y.

Kollmorgan Optical Co., 2 Franklin Ave., Brooklin 11, N. Y.
Astronomical & optical instruments

Kollsman Instrument Div., Square D Co., 80-08—45th Ave., Elmhurst Long Island, N. Y.
Precision instruments for aircraft

Kontes Glass Co., Vineland, N. J.
Glass apparatus, instruments and parts
(See advertisement on page 127)

Krouse Testing Machine Co., 573 E. 11th Ave., Columbus 3, Ohio
Fatigue testing machines

L

L. A. B. Corp., P. O. Box 162, Summit, N. J.
Special instruments

Laboratory Construction Co., 1113-15 Holmes St. Kansas City 6, Mo.
Laboratory furniture & apparatus

Laboratory Equipment Corp., Box 68, St. Joseph, Mich.
Carbon & sulphur determinators

Laboratory Furniture Co., Inc., 37-18 Northern Blvd., Long Island City 1, N. Y.
Laboratory furniture

Laboratory Materials Co., 7319 Vincennes Ave. Chicago 21, Ill.
Laboratory supplies

Laboratory Specialties, Inc., 144 S. Wabash St., Wabash, Ind.
Mirrors—front surfaces & aluminized: Monochromatic light sources, Black light apparatus, Diffraction gratings, Spectroscopes, Fluorescent & phosphorescent materials

Lammert & Mann Co. 260 N. Woods St., Chicago 12, Ill.
Flow rregulators & valves

LaMotte Chemical Products Co., Towson, Md.
Hydrogen ion apparatus

Lampkin Laboratories, Inc., Bradenton, Fla.
Radio-frequency meters

Lancaster Lens Co., 220 N. Main St., Lancaster, Ohio

NEW DESIGN
SURFACE-TYPE THERMOCOUPLE WITH THE "QUICK TIP"

Read temperatures up to 1000°F. on stationary surfaces almost instantaneously with the J-B-T SA-300 thermocouple. It is especially useful in checking heat systems and appliances.

To use, simply attach to a calibrated instrument and press the flat thermocouple junction against the surface of the heat zone to be measured. Spring pressure behind the junction, and a slight swivel in the renewable Transite tip insure firm contact for extremely rapid reading.

Simplified design has made important cost savings possible.

MODEL SA-300, iron constantan, with 4" handle and 5' flexible lead, total res. 3.5 ohms, U.S.A., net each, F.O.B. New Haven.....$5.00

(Interchangeable for all Models 32-JP-2 thru — 5 Oven Testers, also Models 60-JRT and 61-JRT All-Purpose Temperature Testers, where iron-constantan is required. This thermocouple is also available in chromel-alumel and copper-constantan upon special order.)

J-B-T **Ask for Bulletin 549 on the complete J-B-T Line.**

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443 Chapel Street • New Haven 8, Conn.

Landis & Gyr, Inc., 104 Fifth Ave., New York 11, N. Y.
Electric integrating meters; indicating & graphic demand meters for KW, kVA, reactive; prepayment meters; totalizing & remote; time switches; motor wound escapement or synchronous motor types with astronomic dials; miniature ball bearings
(See advertisement on page 27)

Lane Wells Co., Instrument Div., and Ray Control Div., 717 North Lake Ave., Pasadena 19, Calif.
Spectographs and recording spectrometers

Lansing Engineering Co., Electronics Div. 735 E. Kalamazoo St., Lansing, Mich.
Counters & timers

La Pine & Co., Arthur S., 114 W. Hubbard St., Chicago 10, Ill.
Laboratory supplies

Larrimore Sales Co., P. O. Box 1234, St. Louis 1, Mo.
Magnifiers

Lavoie Laboratories Morganville, N. J.
Ultra high frequency precision frequency meter

Lawrence & Hill, Inc., 142 Main Ave., Watertown, N. Y.
Gages & gaging fixtures

Leach Relay Co., 5915 Avalon Blvd., Los Angeles 3, Calif.
Relays

Lear, Inc., 110 Ionia Ave., N. W. Grand Rapids 2, Mich.
Electronic & mechanical aircraft accessories; aircraft radio equipment, radio compasses, etc.

Lectrohm, Inc., 4910 W. 25 Pl., Chicago 50, Ill.
Resistors

Leeds & Northrup Co., 4970 Stenton Ave. Philadelphia 44, Pa.
Electrical measuring instruments for both laboratory & plant. For laboratory: bridges, galvanometers, potentiometers, photometric equipment, test sets & standards. For plant: indicators, recorders & controllers for chemical concentration, CO_2, current, electrolytic conductivity frequency, gas analysis, humidity, Kw, Rkva, light, electrical load, pH, pressure, pyrometry, radiation, smoke density, speed temperature, voltage, Speedomax Recorders, Centrimax Flowmeters & Metermax Combustion control Systems

Leitz Inc., E., 304 Hudson St., New York 13, N. Y.
Optical instruments

Lektra Labs., Inc., 30 E. 10 St., New York 3, N. Y.
Timing devices

Leeds Instrument Co., 2010 Chancellor St., Philadelphia 3 Pa.
Optical and technical instruments

Lenkurt Electric Co., 1118 County Road, San Carlos, Calif.
Ultrasonic-frequency transformers, metallic dust cored; inductors, electric wave filters

Leslie Co., Lyndhurst, N. J.
Pressure reducing valves, pump governors, temperature regulators
(See advertisement on page 16)

Leupold & Stevens Instruments, 4445 N. E. Glisan St., Portland 13, Ore.
Recorders & indicators, for irrigation, power, waterworks, sewerage. Equipment for hydraulic laboatories. Snow-rain recorders, hydrographic accessories, transits, levels

Levin & Son, Louis, 782 E. Pico Blvd., Los Angeles, Calif.
Instrument lathes

Lewis & Co., J. B., 3324 Main St. Hartford 5, Conn.
Motor controls, adjustable speed-electronic exciters

Lewis Engineering Co., 52 Rubber Ave., Naugatuck, Conn.
Portable pyrometers, potentiometers, resistance thermometrs & other electrical tmperature measuring devices
(See advertisement on Back Cover)

Lewyt Metal Products, 60 Broadway, Brooklyn 11 N. Y.
Instrument housings

Lindberg Engineering Co., 2450 W. Hubbard St., Chicago 12, Ill.
Laboratory furnaces and controls

Lincoln Park Industries, Inc., 1719 Ferris Ave., Lincoln Park 25, Mich.
Precision inspection equipment

Linde Air Products Co., 30 E. 42nd St. New York 17, N. Y.
Gas gages, gas flowmeters, oxygen regulators

Link Aviation Devices, Inc., Binghamton, N. Y.
Aircraft navigational instruments

Link Engineering & Mfg. Co., 13845 Elmira St., Detroit 27, Mich.
Spring testers

Liquidometer Corp., 36-16 Skillman Ave., Long Island City 1, N. Y.
Liquid level gages
(See advertisement on page 57)

Liquid Scale Gauge Co., 100 N. First St., Minneapolis 1, Minn.
Liquid level indicating gages

Littelfuse Inc., 4757 N. Ravenswood Ave., Chicago 40, Ill.
Low amperage precision fuses & fuse mountings
(See advertisement on page 48)

Lonergan Co., J. E., 213 Race St., Philadelphia, Pa.
Pressure gages

Lord Mfg. Co., 1635 W. 12 St., Erie, Pa.
Bonded rubber vibration isolation mountings & flexible couplings for practical horsepower motors

L & R Manufacturing Co., 577 Elm St., Arlington N. J.
Instrument cleaning machines & cleaning & rinsing solutions. Crystal cement

Luers, J. Milton, 12 Pine St., Clemens, Mich.
Timers

Lufkin Rule Co., 1730 Hess Ave., Saginaw, Mich.
Precision tools & measuring tapes

Lumenite Electronic Co., 407 S. Dearborn St. Chicago 5, Ill.
Photoelectric controls

Lundquist Tool & Mfg. Co., 57 Jackson St., Worcester 8, Mass.
Ammeters

Lux Clock Mfg. Co., 95 Johnson St., Waterbury 91, Conn.
Automatic timers & clock mechanisms

Lyman Electronic Corp., 12 Cass St., Springfield Mass.
Radio test instruments

M

Macalaster Bicknell Co., 234 Broadway, Cambridge 39, Mass.
Laboratory glass apparatus

Macbeth Corp., 227 West 17th St., New York 11, N. Y.
Hydrogen ion meters
(See advertisement on pages 62, 128)

Macbeth Daylighting Corp., 227 West 17 St., New York 11, N. Y.
Daylight lamps for titration & color matching

WITH precision accuracy and matchless dependability our "glass-masters" are prepared to fabricate any specific glass apparatus requirement for the instrument industry. We are actively engaged in the manufacture of scientific glassware, and are equipped to supply your "tailor-made" needs swiftly, efficiently and at low cost.

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KONTES GLASS COMPANY
VINELAND • NEW JERSEY

Machlett Laboratories, Inc., Springdale Conn.
Vacuum tubes

Machlett & Son, E., 220 East 23rd St., New York 10, N. Y.
Labcratory apparatus & supplies

MacDonald Co., Inc., W. S. 33 University Road, Cambridge 38, Mass.
Microammeters, bolometers and magnetometers
(See advertisement on page 42)

MacLeod & Hancpol, Chelsea & Joiner St., Charlestown 29, Mass.
Radio testing instruments

Madison Electrical Products, Div., John G. Ruckelshaus Co., Madison, N. J.
Chokes, resistances

Magnaflux Corp., 5900 Northwest Highway Chicago 31, Ill.
Magnetic inspection equipment

Magnatrol Valve Corp., 67 Fifth Ave., Hawthorne, N. J.
Control valves

Magnavox Co., Inc., 2131 Bueter Rd., Fort Wayne 2, Indiana
Electrolytic capacitors

Magneswitch, Inc., 4840 S. St. Louis Ave., Chicago 32, Ill.
Liquid level alarms and controllers

Magnetic Analysis Corp., 42-44 12th St., Long Island City 1, N. Y.
Magnetic inspectors for uniform cross-sectional steel

Magnetrol, Inc., 2110 S. Marshall Blvd., Chicago 23, Ill.
Flow and level controls
(See advertisement on page 40)

Mahady Co., E. F. 857 Boylston St., Boston 16, Mass.
Laboratory supply house

Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
Capacitors, relays & switches

Manbee Equipment Co., Inc., 3517 West Madison St., Chicago 24 Ill.
Automotive service instruments

Manning Maxwell & Moore, Inc., Bridgeport 2, Conn.
Thermometers, glass, dial & recording; controllographs; indicating & recording controllers; diaphragm motor valves; tachometers, barometers; & hygrometers

Mansfield & Green, 1051 Power Ave., Cleveland 14, Ohio
Gages and dead weight testers
(See advertisement on page 49)

Marble-Card Electric Co., Gladstone Mich.
Fractional H P motors

Marine Compass Co., Pembroke, Mass.
Marine instruments

Marion Electrical Instrument Co., Manchester, N. H
Electrical indicating instruments

Maris Co., John M., 528 Arch St., Philadelphia 6, Pa.
Laboratory apparatus

Marsh Corp., Jas. P. 3501 Howard St., Skokie, Ill.
Indicating gages, recording gages, dial thermometers, recording thermometers, refrigeration service instruments, temperature controlling systems, valves for heating systems
(See advertisement on pages 55, 104)

Marshall Co., C. & E., 1445 West Jackson Blvd., Chicago 80 Ill.
Manufacturers & distributors of jewelers, watchmakers & engravers supplies

Marshall Co., L. H., 270 W. Lane Ave., Columbus, Ohio
Laboratory furnaces

Marshalltown Mfg. Co., Marshalltown, Iowa
Pressure gages & indicating thermometers

Martin-Hubbard Corp., 11 Beacon St., Boston 8 Mass.
Designers of electrical, mechanical and optical instruments
(See advertisement on page 31)

Mason-Neilan Regulator Co., 1190 Adams St., Boston 24, Mass.
Industrial control equipment for pressure temperature, flow, liquid level, combustion & ratio, diaphragm control valves; pressure & vacuum regulators; level controllers; pump speed governors; pump pressure regulators; pipe strainers
(See advertisement on page 39)

THE FIRST LINE OPERATED DIRECT READING CONTINUOUS INDICATING pH METER

MACBETH pH METER

No batteries whatsoever. Can be left on continuously. Only one operating control. Large, easily read scale. Range—from 0 to 14 pH. Untrained users can make ordinary pH measurements.

Write for Bulletins

MACBETH CORPORATION

227 West 17th Street New York 11, N. Y.

Macbeth Corporation

Massa Laboratories Inc., 3868 Carnegie Ave., Cleveland 15, Ohio
Acoustic instruments, sound pressure measurement standards

Matthews Instrument Co., 1129 Boylston St., Newton Upper Falls, Mass.
Odometers

Maurer, Inc., J. A., 37-01 31 St., Long Island City, 1 N. Y.
Motion picture cameras

Maveg Machine Sales Association, Chamber of Commerce Bldg., Long Island City, N. Y.
Dilatometers, dual comparators

Maxson Corp., W. L., 460 West 34 St., New York 1, N. Y.
Aircraft instruments, computing machines, integrators gyro stabilizers, aircraft and naval current controls

Maymer Corp., 10884 Berea Rd., Cleveland 2, Ohio
Scales, dials & templates

M B Instruments, Inc., 331 East St., New Haven 11 Conn.
Electrical instruments

McAlear Manufacturing Co., 1911 S. Western Ave., Chicago 8, Ill.
Manual & automatic controls for air, oil, gas, steam, chemicals pure food, acid & alkali

McDonnell Odometers Co., 3501 So. Kedzie Ave., Chicago 32, Ill.
Counters

McFarlin Co., 29 West Marion Ave., Youngstown 2, Ohio
Leak detectors

McKesson-Doster-Northington Co., 1706 First Ave., Birmingham 3, Ala.
Laboratory supplies

McNeill Engineering Co., S. J., 4057 West Van Buren St., Chicago 24, Ill.
Smoke alarms

Mead Specialties Co., 4114 North Knox Ave., Chicago 41, Ill.
Control valves

Measurements Corp., Boonton, N. J.
Radio frequency Testing & Measuring Devices
(See advertisement on pages 61, 72, 93, 114)

Mechanical Industries Production Co., 209 Ash St., Akron 3 Ohio
Thermostats

Meletron Corp., 950 N. Highland Ave., Los Angeles 38, Calif.
Pressure operated switches
(See advertisement on page 92)

Mellaphone Corp., 714 University Ave., Rochester 2, N. Y.
Rectifiers

Mercoid Corp., 4233 Belmont St., Chicago 14, Ill.
Automatic controls for heating, refrigeration air conditioning & various industrial applications
(See advertisement on page 17)

Mercon Regulator Co., 2357 N. 29th St., Milwaukee 10, Wis.
Power plant specialties in regulation of pressure, level, rate of flow, proportioning & temperature

Mercury Glass Co., Pleasantville, N. J.
Glass tubing

Meriam Instrument Co., 10920 Madison Ave. Cleveland 2, Ohio
Manometers, draft gages, indicating flow meters for steam, oil, gas, air, water, tank liquid level gages
(See advertisement on pages 48, 54, 65, 67)

Merit Coil & Transformer Corp., 4427 No. Clark, Chicago 7, Ill.
Transformers, coils & reactors, electrical windings
(See advertisement on page 110)

Merkle Korff Gear Co., 214 North Morgan St., Chicago 7, Ill.
Motorized speed reducers: induction, synchronous, reversing, d-c universal motors

Merrick Scale Mfg. Co., Autumn St., Passaic, N. J.
Automatic continuous weighing machines

Merritt Engg. & Sales Co., Inc., 120 So. Niagara St., Lockport, N. Y.
Consistency controls

Merz Engineering Co., 200 S. Harding St., Indianapolis 7 Ind.
Gages & gaging fixtures

Metlab Equipment Corp., 1529 Dean St., Brooklyn 13, N. Y.
Laboratory furniture

Meter Devices Co., 1001 Prospect Ave., S. W., Canton 6, Ohio
Electrical test devices

Meters, Incorporated, 915 Riveria Dr., Indianapolis 5 Ind.
Electrical indicating instruments

Metron Instrument Co., 432 Lincoln St., Denver 9, Colo.
High frequency amplifiers, electric instruments, oscillators, radio remote control systems, comparator gages electric tachometers, timers, chronographs

Metzger & Son., F. F., 2600 N. 6 St., Philadelphia 33, Pa.
Extensometers and gages

Meyer Scientific Supply Co., Inc., 221 Atlantic Ave. Brooklyn 2, N. Y.
Laboratory apparatus

Meyer Governor Co., 284 Baker Bldg., Minneapolis 2, Minn.
Long-distance recording, indicating, and contact-making instruments; gage pulsation protectors

M-G Gage Co., 637 South West St., Syracuse 4 N. Y.
Snap gages

Mice Instrument Co., 80 Trowbridge St., Cambridge, Mass.
Precision devices in industrial & scientific fields
(See advertisement on page 43)

Microchemical Service, 30 Van Zandt Ave., Douglaston, N. Y.
Microchemical laboratory apparatus

Micro Master Co., 2733 N. Pulaski Rd., Chicago 39 Ill.
Dial indicators & taper gages

Micro Metallic Corp., 193 Bradford St., Brooklyn 7, N. Y.
Pressure snubbers

Micro Switch Div., First Industrial Corp., Spring St., Freeport, Illinois
Snap action switches

Mid-West Dynamometer & Engg. Co. 3100 River Road, River Grove, Ill.
Dynamometers

Millen Mfg. Co., James, 150 Exchange St., Malden, Mass.
Radio test instruments

Miller, M. C., 1142 Emerson Ave., W. Englewood, N. J.
Electrical instruments

Miller Transformer Co. B. F., P. O. Box 568, Trenton 4, N. J.
Transformers

Miller & Weber, Inc., 71-14 Myrtle Ave., Glendale 27, L. I., N. Y.
Liquid-in-glass thermometers

Millers Falls Co., Greenfield Mass.
Machine shop gages

Millivac Instruments, P. O. Box 3027, New Haven, Conn.
Special electronic instruments
(See advertisement on page 114)

Milton Roy Company, 1309 E. Mermaid Ave., Philadelphia 18, Pa.
Automatic feeders & flow controllers
(See advertisement on page 81)

Milwaukee Gas Specialty Co., 730 N. Jackson St., Milwaukee 1, Wis.
Valves, fittings & safety shut-offs for gas fired equipment

Milwaukee Lock and Mfg. Co., 5024 N. 37 St., Milwaukee 9 Wis.
Governors, tachometers

Mine Safety Appliances Co., Braddock, Thomas and Meade Sts., Pittsburgh 8, Pa.
Instruments for the detection, analysis & recording of toxic and combustible gases; instruments for sampling, counting & measuring dust particles

Mine & Smelter Supply Co., 1422-17th St., Denver Colo.
Industrial equipment & supplies

Minneapolis Elec. & Construction Co. 80 South 12th St., Minneapolis 4, Minn.
Wire length measuring machines

Minneapolis-Honeywell Reg. Co., 2727 - 4 Ave., S. Minneapolis 8, Minn.
Heating, ventilating and air conditioning control equipment; thermostats; safety controls; motor and diaphragm operated valves; relays; furnace controllers

Model Engineering & Mfg. Co., Huntington, Ind.
Resistors

Modern Electrical Laboratory, 6131 S. Wentworth Ave. Chicago 21 Ill.
Laboratory apparatus

Modern Kiln & Furnace Co., American & York Streets Philadelphia 33, Pa.
Ovens, furnaces & controllers

Modev Co., 1825 Ravenwood Ave., Dayton, O.

Moeller Instrument Co., 132nd St. & 89th Ave., Richmond Hill, N. Y.
Thermometers hydrometers, etc.
(See advertisement on page 102)

Moisture Register Co., 133 N. Garfield Ave., Alhambra, Cal.
Moisture testing instruments & devices

Moline Furniture Works, Moline, Ill.
Laboratory furniture

Monarch Manufacturing Co., 2014 N. Major Ave., Chicago 39, Ill.
Radio set testers

Monarch Manufacturing Works, Inc., Salmon & Westmoreland Sts. Philadelphia, Pa.
Strainers, oil burner nozzles & regulating valves, viscosimeters

Montgomery Mfg. Co., Dept. 296, 549 W. Washington Blvd., Chicago 6 Ill.
Program clocks

Moore Products Co., 901 E. Lycoming St., Philadelphia 24, Pa.
Industrial instruments

Morehouse Machine Co., York Penna.
Proving rings

Morganite, Inc., 3302-3320 48th Ave., Long Island City 1, N. Y.
Pyrometer tubes

Mosher Electronic Control Systems, 130 W. 42 St. New York 18, N. Y.
Electronic bin level indicators & electronic load regulators for pulverizing machinery

Mossman, Inc., Donald P. 612 N. Michigan Ave. Chicago 11, Ill.
Switches

Municipal Instrument Co., 3246 S. Cuyler Ave., Berwyn, Ill.
Magnetic dipping needles, pipe phone for checking leaks

Munsell Color Co., Inc., 10 E. Franklin St., Baltimore 2 Md.
Color comparators

Mu-Switch Corp., 38 Pequit St., Canton, Mass.
Snap action switches

Muter Co., 1255 S. Michigan Ave., Chicago 5, Ill.
Resistors

N

Nash Engineering Co., 370 Wilson Road,, South Norwalk, Conn.
Instrument air compressors
(See advertisement on page 10)

Nashville Surgical Supply Co. 401 Church St., Nashville 3, Tenn.

Nason Co., 7663 Epworth Blvd., Detroit 4, Mich.
Controllers & testing devices

Nathan Mfg. Co., 250 Park Ave., New York 17, N. Y.
Valves

National Brass Co., 1600 Madison St., S. E., Grand Rapids 2 Mich.
Combustion & draft controllers

National Carbon Co., Inc., Carbon Products Div., P. O. Box 6087, Cleveland 1, Ohio
Accelerated weathering testers

National Co., Inc., 61 Sherman St., Malden, Mass.
Capacitors and radio instruments

National Electric Controller Co., 5305 Ravenswood Ave. Chicago 40, Ill.
Rheostats

National Engineering Products Inc., Commerce & Savings Bldg., Washington 4, D. C.
Pressure gage equalizers

National Instrument Co., 246 Walnut St., Newtonville 60 Mass.
Electro-mechanical instruments & devices

National Research Corp., 70 Memorial Drive, Cambridge 42, Mass.
Optical products, high vacuum apparatus

National Scientific Co., 2204 W. North Ave., Chicago 47, Ill.
Laboratory supply house

National Technical Labs. 820 Mission St., South Pasadena, Calif.
Beckman pH instruments and electro-metric pH equipment for completely automatic indication, control & recording of pH in large scale industrial processes

National Time & Signal Corp., 21800 Wyoming Ave., Detroit 20, Mich.
Timers for welding & industrial process control

Nazon Utilities Corp., 3600 W. Touhy Ave., Chicago 45, Ill.
Instrument cleaning machines

Negus, T. S. & J. D., 69 Pearl St., New York 4, N. Y.
Nautical instruments

Nelson Section Liner Co., 229 W. Gardner St., DeKalb, Ill.
Drawing instruments

Nelson Vacuum Pump Co. Geo. F., 2133 4th St., Berkeley 2, Calif.
High vacuum pumps

Neptune Meter Co., 50 W. 50th St., New York 20, N. Y.
Liquid meters

Nester Company, Inc., L. G., Millville, N. J.
Oxygen regulators

Newark Wire Cloth Co., 336 Verona Ave., Newark, N. J.
Testing sieves

New Hampshire Ball Bearings Inc., 2 Main St., Peterborough, N. H.
Miniature ball bearings

N. J. Laboratory Supply Co., 235 Plane St., Newark, N. J.
Laboratory supplies

New Jersey Meter Co., Plainfield, N. J.
Compressed air meters, separators for removing water & oil from compressed air lines, liquid flow indicators with low flow signaling circuit

N. Y. Laboratory Supply Co., Inc., 76 Varick St New York 13, N. Y.
Laboratory supplies

New York Scientific Supply Co., 28 West 30 Street, New York, N. Y
Laboratory supplies

New York Transformer Co., Alpha, N. J.
Transformers

Newark Scale Works, 10-12 Hobson St., Newark 8 N. J.
Scales

Niagara Electrical Instrument Co., 559 Ellicott St., Buffalo, N. Y.
Electrical power analyzer

Nilsson Gage Co., Inc., P. O. Box 505, Poughkeepsee, N. Y.
Dimensional gages

Norcross Corporation, 50 Hunt St. Watertown, Mass.
Humidity controllers and recording viscosimeters

Nordstrom Valve Division of Rockwell Mfg. Co., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Valves

Noris Instruments, Ltd., 105 E. 29th St., New York N. Y.
Drawing instruments

North American Instrument Co., 10-12 Van Cortland Ave., E. Bronx 58, N. Y.
Aircraft instruments

North American Manufacturing Co., 4455 E. 71st St., Cleveland 5, Ohio
Valves and valve operating devices

North American Philips Co., Inc. 100 E. 42nd St., New York 17, N. Y.
X-ray equipment

Northern Equipment Company, 1945 Grove Drive, Erie, Pa.
Boiler feed control

Northwest Instrument Co., 63 Madison St., Seattle, Wash.
Compasses

Norton Electrical Instrument Co., 83 Hilliard St., Manchester Conn.
Electrical instruments

Nosker Engineering Products, Yellow Springs, Ohio
Strain measuring equipment

Nuclear Development Laboratory, P. O. Box 7601, Kansas City, Mo.
Radium detectors

Nuclear Instrument & Chemical Corp., 223 West Erie St., Chicago 10, Ill.
Radioactivity detectors
(See advertisement on page 85)

Nurnberg Thermometer Co., Inc., 124 Livingston St., Brooklyn 2, N. Y.
Thermometers and hydrometers

Nye, Inc., Wm. F., New Bedford, Mass.
Instrument and watch oils
(See advertisement on page 64)

O

Offner Electronics, Inc., 5320 N. Kedzie Ave., Chicago, Ill.
Oscillographs

Ohaus Scale Corp. 10-12 Hobson St., Newark 8, N. J.
Analytical balances

Ohio Thermometer Co., 33 S. Walnut St., Springfield, Ohio
Mechanical thermometers

Ohmite Mfg. Co., 4826 W. Flournoy St., Chicago 44, Ill.
Close control rheostats, fixed & adjustable power resistors, precision & non-inductive resistors, attenuators, tap switches and R. F. chokes.

Olsen Testing Machine Co. Tinius, Easton Road, Willow Grove, Pa.
Testing machines

Olympic Instrument Labs., Cove, Wash.
Measuring machines

Omega Machine Co., 9 Codding St., Providence, R. I.
Chemical feeding equipment for dry or liquid materials, by volume or by weight

Optical Development Corp., 5 Beekman St., New York 7, N. Y.
Magnifiers, microscope accessories

Optical Service & Development, 91 Canal St., New York 2, N. Y.

Optron Laboratory, 2725 Salem Ave., Dayton 6, Ohio
Optical flats reflectors prisms
(See advertisement on page 45)

OPW Corp., 2735 Colerain Ave., Cincinnati 25, Ohio

Oster Mfg. Co. John, Terminal Bldg., 1 Main St., Racine, Wis.
Fractional horsepower motors

P

Pacific Scientific Co., Inc., 1430 Grande Vista Ave., Los Angeles 23, Calif.
Cable tension indicator

Palmer Thermometers, Inc., 2511 Norwood Ave., Cincinnati, Norwood 12, Ohio
Industrial indicating "Red-Reading-mercury" thermometers & dial thermometers
(See advertisement on page 103)

Palo-Myers Inc., 81 Reade St., New York 7, N. Y.
Laboratory supplies & boiler water testing equipment

Palos Optical Co., Box 6, Palos Hts., Ill.
Astronomical instruments, filters, optical flats, lenses, microscopes

Panellit, Inc., 7212 N. Clark St., Chicago 26, Ill.
Instrument panels, pressure indicators

Panoramic Radio Corp., 245 W. 55th St., New York, N. Y.
Electronic instruments and inspection devices

Paragon Electric Co., Two Rivers, Wis.
Timers

Park Sales Co., 421 Canal St. New York 13, N. Y.
Micrometers and calipers

Parker Appliance Co., 17325 Euclid Ave., Cleveland 12, Ohio
Pressure snubbers, valves, fittings for instrument tubing

Parks Co., Harry S., 101 North 33 St., Philadelphia, Pa.
Gages pressure instruments

Parr Instrument Co., 211-53 St., Moline, Ill.
Combustion bombs, calorimeters, hydrogenation apparatus, melting point apparatus

Partlow Corp., 2 Campion Rd., New Hartford, N. Y.
Temperature indicators & controllers, time delay relays

Passaic Analytical Laboratories, Inc., 228 Ayerigg Ave., Passaic, N. J.
Instrument cleaning machines
(See advertisement on page 64)

Pastor Stop Watch Co., 43 East Main St., Waterbury 22, Conn.
Stop watches

Patterson Screen Div., E. I. duPont de Nemours & Co., Towanda, Pa.
X-ray intensifying and fluorscopic screens

Paul Valve Co., 683 Third Ave., New York 17 N. Y.

Paulstick & Sons, H. 2124 Fulton St., Brooklyn 33, N. Y
Thermometers

Pelouze Mfg. Co., 1228 Chicago Ave., Evanston, Ill.
Torque gages
(See advertisement on page 95)

Penn Industrial Instrument Corp., 3116 N. 17th St., Philadelphia 32 Pa.
Flow meters
(See advertisement on page 68)

Penn Optical & Inst. Co., 50 S. San Gabriel Blvd., Pasadena 8, Calif.
Optical parts

Perfex Corp., 500 W. Oklahoma Ave., Milwaukee 7, Wis.
Automatic temperature controls for oil burners, stokers, gas burners, refrigeration & air conditioning

Perkin-Elmer Corp., 535 Hope St. Glenbrook, Conn.
Optical instruments

Perkins & Son, Inc., B. F., Holyoke Mass
Testers for leather, paper & textiles
(See advertisement on page 95)

Permo Incorporated, 6415 Ravenswood Ave. Chicago 26, Ill.
Instrument pivots & Contacts
(See advertisement on page 131)

Permutit Company, 330 West 42nd St., New York 18, N. Y.
Indicators & recorders for CO_2, specific gravity of natural manufactured or process gases, exhaust gas analysis, other uses where gas density guides operation

Petrometer Corp., 1 Star Square, Long Island City 1 N. Y.
Distant reading, liquid level tank gages

Pfaltz & Bauer, Inc., 350 5th Ave., New York 1, N. Y.
Laboratory control instruments

Philadelphia Gear Works, Inc., G St. and Erie Ave., Philadelphia Pa.
Control valves

Philadelphia Thermometer Co., 6th and Cayuga Sts., Philadelphia 40, Pa.
Instruments for temperature indication, control & regulation
(See advertisement on page 104)

Philbrick Researchers, Inc., George A., 230 Congress St., Boston 10, Mass.
Computers and analogs
(See advertisement on page 23)

Phillips Control Corp., 612 N. Michigan Ave. Chicago 11, Ill.
Relays and solenoids

Philips Manufacturing Co., 3475 W. Touhy Ave., Chicago, Ill.
Vapor degreasers & instrument cleaning machines

Phipps and Bird, Inc., 6th & Bird Sts., Richmond 5, Va.
Laboratory apparatus & chemicals

Phoenix Precision Instrument Co., 3803 N. 5th St. Philadelphia 40, Pa.
Laboratory equipment

Photocon Research Products, 1061 N. Allen Ave., Pasadena 7, Calif.
Precision mechanical instruments

Photo Research Corp., 15024 Devonshire St., San Fernando, Calif.
Optical instruments and testers

Photron Instrument Co., 5713 Euclid Ave., Cleveland 3 Ohio
Photoelectric colorimeters

Photoswitch, Inc., 77 Broadway, Cambridge, Mass.
Industrial photoelectric controls including counting equipment, electronic timers & special electronic controls, smoke controls

Photovolt Corp., 95 Madison Ave., New York 16, N. Y.
Photo-electric elements, photometers electronic timing devices, photo-electric colorimeters, photo-electric exposure meters, densitometers

Physicists Research Co., 321 S. Main St., Ann Arbor, Mich.
Specialists in solution of unusual industrial research jobs, with special experience in machinery noise reduction, development of special instrumnts, & measurement of surface irregularities

Picker X-Ray Corp. 300 Fourth Ave., New York 10, N. Y.
X-ray equipment

Pickering Governor Co., Pickering St., Portland, Conn.
Governors

Pierce Watch Company, 22 West 48th St., New York 19, N. Y.
Stop watches

Pike & Co., E. W., Elizabeth 13, N. J.
Illuminated magnifiers & microscopes

Pipe Machinery Co., 930 E. 70th St. Cleveland, Ohio
Inspection gages

Pitometer Log Corp., 237 Lafayette St., New York 12, N. Y.
Pilot tube flowmeters

Pittsburgh Instrument & Machine Co., 1026 Reedsdale St., Pittsburgh 12, Pa.
Brinell Machines, alternating impact machines, surveying instruments
(See advertisement on page 98)

Plumb Co., D. S., 73-77 Norfolk St., Newark 4, N. J.
Pressure gage movements
(See advertisement on page 50)

Plummer & Kershaw, 2757 Frankford Ave., Philadelphia 34, Pa.
Optical parts
(See advertisement on page 73)

Pneumercator Co., Inc., 305 E. 46 St., New York 17, N. Y.
Level indicators

Polarad Electronics Co., 9 Ferry St., New York 7 N. Y.
Amplifiers, audiofrequency equipment, oscilators, remote control equipment

Polarized Light-Photoelastic Co., 96 Tompkins Circle, Staten Island 1, N. Y.
Photoelastic polariscopes

Polarizing Instrument Co., Mount Kisco, N. Y.
Photoelasticity apparatus

Poole Instruments Inc., 1816 Magnolia St., Dallas 1, Texas
Tube inside micrometer for big gun internal measurements and refinery still tubes

Porter, George K., Hatboro, Pa.
(See advertisement on page 60)

Post Company, Frederick, P. O. Box 803, Chicago 90, Ill.
Instruments & equipment for architect & engineer

Post Machinery Co. Div., Reid Bros. Co., 140 Elliott St. Beverly, Mass.
High speed electronic counter

Potter & Brumfield Sales Co., 549 W. Washington St., Chicago 6, Ill.
Relays

Potter Co., 1950 Sheridan Rd., North Chicago, Ill.
Capacitors

Potter Instrument Co., 136 Roosevelt Ave., Flushing, N. Y.
Photoelectric counters and controls

Powers Regulator Co., 2734 Greenview Ave. Chicago 14, Ill.
Controls for air conditioning temperature & humidity; also water temperature controls, dial indicating & recording thermometers & steam traps

Pratt & Whitney, Div. Niles-Bement Pond Co., West Hartford, Conn.
Machine shop instruments

Precision Apparatus Co., Inc., 92-27 Horace Harding Blvd., Elmhurst, L. I. N. Y.
Radio test instruments

Precision Gage & Tool Co., 320 East 3d St., Dayton 2, Ohio
Machine shop gages

Precision Products, Inc., 516 South Lansing St., Tulsa 5, Okla.
Time switches

Precision Radiation Instruments, Inc. 1101 N. Paulina St., Chicago 22, Ill.
Alpha, beta and gamma counters

Precision Resistor Co., 334 Badger Ave., Newark 8, N. J.
Resistors

Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Standard & custom-built laboratory equipment

Precision Thermometer & Instrument Co., 1434 Brandywine St., Philadelphia 30, Pa.
Scientific instruments

Precision Tube Company, 3824-26-28 Terrace St., Philadelphia, Pa.
Fine tubing & metal shielded wire
(See advertisement on page 110)

Preferred Utilities Mfg. Corp., 1860 Broadway, New York, N. Y.
Boiler plant instruments

Premier Crystal Labratories, Inc., 79 Seventh Ave. New York 11, N. Y.
Piezo electric quartz and tourmaline crystals, reactance & capacity meters

Price Electric Corp., Frederick, Md.
Relays

Process Controls Co., 2 East End Ave., New York 21, N. Y.
Designers and builders of electrical, mechanical and electronic controls for automatic equipment and processes

Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Scientific Instruments

Production Instrument Co., 710 W. Jackson Blvd., Chicago 6, Ill.
Electric & mechanical counting, timing & recording devices & actuating switches
(See advertisement on page 43)

Proportioneers, Inc., 188 Codding St., Providence 1, R. I.
Automatic controlling & proportioning equipment

Pyle National Co., 1334 N. Kostner Ave. Chicago 51, Ill.
Connectors

Pyrometer Instrument Co., Inc., Bergenfield 4, N. J.
Pyrometers for various purpses
(See advertisement on page 80)

Pyrometer Service Co., 228 River Rd., Arlington, N. J.
Pyrometer tubes, thermocouples

R

Racine & Co., Jules, 20 West 47th St., New York 19, N. Y.
Stop watches

Radex Corp., 2076 Elston Ave., Chicago 14, Ill.
Electrical testers

Radiation Counter Labs., 1844 W. 21 St., Chicago 8, Ill.
Geiger-Muller counters, radium detectors

Radio City Products, Inc., 127 W. 26th St., New York 7, N. Y.
Electrical & radio testing instruments &

Radio Frequency Laboratories Inc., Boonton, N. J.
Electronic equipment

Radio Receptor Co., Inc., 251 W. 19th St., New York 11, N. Y.
Radio test instruments, remote control sy

Ranco, Inc., 601 West Fifth Ave., Columbus 1,
Refrigeration controls

Rapidesign, Inc. P. O. Box 592, Glendale, Calif.

Rascher & Betzold, Inc., 730 N. Franklin St., Chicago 10, Ill.
Laboratory supplies

Rauland Corp., 4245 N. Knox Ave., Chicago 11, Ill.
Cathode ray tubes

Rauland-Borg Corp., 3523 W. Addison St., Chicago 18 Ill.
Amplifiers, audio-frequency equipment, micr

Rawson Electrical Instrument Co., 112 Potter St. Cambridge, Mass.
Dynamometers, wattmeters, milliameters & voltmeters. Also ultra-sensitive meters both for A.C. & D.C. fluxmters, electrostatic voltmeters, Thermocouples & vacuum earth current meters, cable testers, mil second timers

Raytheon Mfg. Co., 190 Willow St., Waltham 54, Mass. Automatic & manually controlled rectifiers for all communication, industrial or laboratory applicatio

RCA Division, Radio Corporation of America, Camden, N. J.
Radio & electronic equipment for all purposes including laboratory & industrial apparatus

Read Machinery Co., Inc., York, Penna.
Chemical and industrial equipment

Redington Co. F. B., 112 S. Sangamon St., Chicago 7, Ill.
Counters: production, revolution, stroke

Redmond Co., Inc., Owasso, Mich.
Fractional horsepower motors

Reeder & Co., Charles M., 171 Victor Ave., Detroit 3, Mich.

Reeves Hoffman Corp., 321 Cherry St., Carlisle, Pa.
Piezoelectric and quartz crystals

Reeves Instrument Corp. 215 E. 91 St., New York N. Y.
Computers

Refinery Supply Co., 621 East Fourth St., Tulsa, Okla.
Gas testing instruments & specialties for oil & gas industry; & laboratory supplies
(See advertisement on page 132)

Reiner Electronics Co., 152 W. 25th St., New York 1, N. Y.
Electronic testing equipment

Reliance Gauge Column Co., 5902 Carnegie Ave. Cleveland 3, Ohio
Steam specialties

Reliance Instrument Co., 3027 W. Van Buren St. Chicago 22, Ill.
Electrical indicating instruments

Republic Flow Meters Co., 2240 Diversey Parkway, Chicago 47, Ill.
Remote reading flow meters, complete line of power plant & industrial instruments for the measurement of flow, level pressure, draft, temperature & CO_2. Automatic boiler controls, regulators, valves and de superheaters
(See advertisement on pages 32, 37, 46, 55, 86, 113)

Resistance Products Co., 714 Race St., Harrisburg, Pa.
Resistors

Resistors, Inc., 5226 West 26 St., Chicago 50, Ill.
Resistors adjustable, variable & wire wound

Revere Corporation of America, P. O. Box 304, Wallingford, Conn.
Thermocouples for liquids, air, metal, hot gases, thermocouple wire, hardnesses and leads. Pitot tubes (shielded and unshielded). Engine & Flight test recording accessories

Rex Rheostat Co., 3 Foxhurst Rd., Baldwin L. I., N. Y.
Protected and unprotected slide-contact rheostats & adjustable, wire wound resistors
(See advertisement on page 89)

Reynolds Gas Regulator Co., Anderson, Ind.
Automatic valves & regulators

Rhoades Metaline Co., Inc., R. W., 50-17 Fifth St., Long Island City 1, N. Y.
Rubber stoppers

Rhodes, Inc., M. H., 30 Bartholomew Ave., Hartford 6, Conn.
Time switches

Eise's Sons, Bernard, 325 Fifth Ave., New York, N. Y.
Frequency meters, raido frequency oscillators, vacuum thermocouples and thermopiles

Richards Co., Inc., Arklay S., 52 Winchester St., Newton Highlands, Mass.
Thermocouples, lead wire & protection tubes
(See advertisement on page 102)

Richardson-Allen Corp., 15 W. 20 St., New York, N. Y.
Timers and time switches

Richardson Scale Co., Clifton, N. J.
Automatic weighing machinery

Riehle Testing Machine Division, American Machine & Metals Inc., East Moline, Ill.
Testing machines & testing instruments for tension, compression, bending, torsion, shear, hardness, wear

Ricker Instrument Co., 1919 Fairmount Ave., Philadelphia 30 Pa.
Scientific instruments

Rimat Machine Tool Co., 1117 Air Way, Glendale 1, Calif.
Micrometers

Ritchie & Son, R. S., 112 Cypress St., Brookline, Mass.
Marine instruments

Riverbank Laboratories, Geneva, Ill.
Tuning forks

R & M Mfg. Co., Royal Oak Mich.
Machine shop gages

Robbins & Myers, Inc., 1345 Lagonda Ave., Springfield 99, Ohio

Robinette Co., W. C., 802 Fair Oaks Ave., S. Pasadena, Cal.
Automatic control devices
(See advertisement on page 38)

Robinson Orifice Fitting Co., 2830 Lugo St., Los Angeles 23, Calif.
Orifice fittings & plates

Rochester Mfg. Co., Inc., 73 Rockwood St., Brighton, Rochester, N. Y.
Pressure & liquid level indicators & thermometers

Rockwell Co., Stanley P., 296 Homestead Ave., Hartford 5, Conn.
Dilatometers

Rockwell Mfg. Co., 400 Lexington Ave., Pittsburgh, Pa.
Fluid meters
(See advertisement on page 67)

Roemer Drug Co., 606 N. Broadway, Milwaukee 4, Wis.
Laboratory supply house

Roller-Smith, 1766 N. Market St., Bethlehem, Pa.
Instruments (indicating & graphic) air & oil circuit breakers, relays, switchboards, precision balances, transformers, instrument & control switches
(See advertisement on page 24)

Rollin Co., 2070 N. Fair Oaks Ave., Pasadena 3, Calif.
Electronic test equipment

Rosen Engineering Products, Inc. Raymond, 32nd & Walnut Sts., Philadelphia 4, Pa.
Telemetering

Rotron Div., Jenkes Knitting Machine Co., 180 Weeden St., Pawtucket, R. I.
Air-operated switches

Rowe Engineering Corp., 2422 N. Pulaski Road, Chicago 39 Ill.
Specialized industrial & laboratory equipment, Electro-mechanical & electronic devices

R-S Products Corp., 4523 Germantown Ave., Philadelphia 44, Pa.
Butterfly valves & heat treating furnaces

Rubicon Co., Ridge Ave. at 35th St., Philadelphia 32, Pa.
Precision electrical instruments: potentiometers, galvanometers, bridges resistance standards, for standardisation, research, calibration of meters, production testing, & educational applacitions. Photoelectric colorimeters, transmission dynamometers & other special apparatus

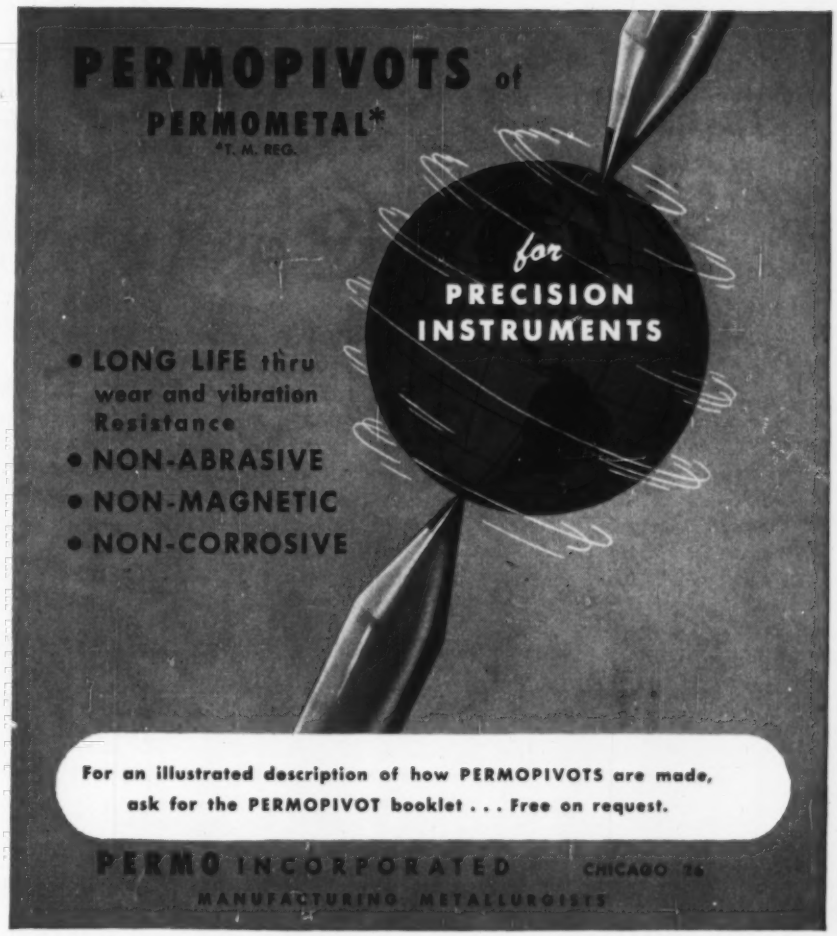
Rudolph & Sons, O. C., P. O. Box 446 Caldwell N. J.
Optical instruments

Ruehfel Co., Inc., George, 93-08 95 Ave., Ozone Park, N. Y.
Laboratory instruments & apparatus

Rupp & Bowman Co., 315 Superior St., Toledo 3, Ohio
Laboratory supplies

Ruska Instrument Corp., 4607 Montrose Blvd., Houston 6, Texas
Geophysical instruments

Rutherford Instrument Co., P. O. Box 7406, Washington 4, D. C.
Polygraph



Rutteo Mfg. Co., 103-04 Metropolitan Ave., Forest Hills N. Y.

Ryan Tool & Engineering Co., 19159 John R. St., Detroit 3, Mich.
Height gages, fixtures, special machinery.

S

Sampsel Time Control, Inc., Spring Valley, Ill.
Combustion control equipment

Sanborn Co., 39 Osborne St., Cambridge, Mass.
Electronic instruments
(See advertisement on page 81)

Sangamo Electric Company, 1022 Converge Ave., Springfield, Ill.
Electric meters of all types; also instrument transformers, time switches & radio condensers

Sarco Company, Inc., 475 5th Ave., New York 17, N. Y.
Temperature regulators

Sargent & C., E. H., 155 E. Superior St., Chicago 11, Ill.
Laboratory supplies & chemicals

Saxl Instrument Co., Harvard, Mass.
Tension and torque measuring instruments

Schaar & Co., 754 W. Lexington St., Chicago 7, Ill.
Laboratory supplies

Schade Valve Mfg. Co., 2527 N. Bodine St., Philadelphia 33 Pa.
Automatic valves

Schaefer Bros., Co., 1059 W. 11th St., Chicago 7 Ill.
Rheostats

Schaevitz Engg., Cresceent Blvd. at Drexel Ave., Camden, N. J.
Accelerometers, extensometers position indicators, remote metering equipment
(See advertisement on page 18)

Schaffer Poidometer Co., 2828 Smallman St., Pittsburgh 22, Pa.
Scales

Schauer Machine Co., 2060 Reading Rd., Cincinnati 2, Ohio
Battery chargers, battery eliminators and rectifiers

Scherr Co., Inc., George 200 Lafayette St., New York 12, N. Y.
Optical measuring and inspection equipment

Schneider-Cogswell, Inc., 1849 Halstead St., Chicago 14, Ill.
Precision lenses and prisms

Schutte & Koerting Co., 12th & Thompson Sts., Philadelphia 22, Pa.
Rotameters

Schwein Engg. Co., L. N., 5736 Washington Blvd., Los Angeles, Calif.
Aircraft instruments & pressure control instruments

S & C Electric Co., 4435 Ravenswood Ave., Chicago 40, Ill.
High voltage testers, voltage detectors

Scientific Apparatus Co., 4 Landscape Ave., Yonkers 5, N. Y.
Laboratory apparatus

Scientific Glass Apparatus Co., Inc., 49 W. Ackerman St., Bloomfield, N. J.
Glass apparatus & interchangeable ground glass joints

Scientific Instrument Co., 1041 Second St., Detroit 26, Mich.
Industrial & laboratory thermometers; hydrometers; special laboratory apparatus

Scientific Supplies Co., 12 Jackson St., Seattle 1, Wash.

Scott, Inc., Hermon Hosmer, 385 Putnam Ave., Cambridge, Mass.
Electronic instruments

Scott Testers, Inc., 101 Blackstone St., Providence, R. I.
Testing machines

S & D Engineering Co., Angle Computer Div., 1709 Standard Ave., Glendale 1, Calif.

MANUFACTURERS and JOBBERS

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MANUFACTURERS OF

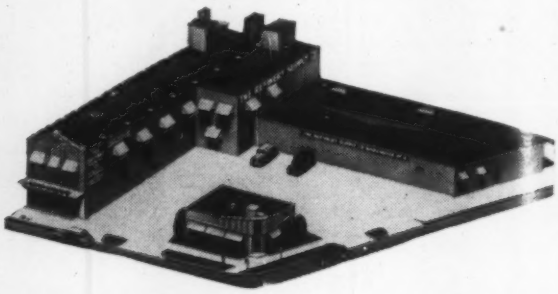
AC - ME and R. S. SPECIALTIES

For Natural and Artificial Gas and Gasoline Industry

SPECIAL SERVICE DEPT.—SPECIAL GLASSWARE BLOWN TO ORDER

We are equipped with Precision Machine Shop to handle all small, accurate machine work.

Repair Department for Hays Analyzers, Manometers, Indicating Pressure Gauges, etc.



Ac-Me Recording Gravitometer
Ac-Me Specific Gravity Gas Balance
Ac-Me Pressure Vacuum Pump
R. S. Portable Vacuum Pump
R. S. Mercury Cleaner
R. S. Manometer
R. S. Dead Weight Gauge

R. S. Dead Weight Tester
R. S. Orifice Well Tester
R. S. Moisture Tester
R. S. Flat Bore Yel-O-Bak Thermometers
R. S. Streamlined Hydrometers
R. S. Pulsameter

R. S. Pressure Hydrometer Jars
R. S. Vapor Pressure Bomb
R. S. Diamond Core Drill
R. S. Thermo Plumb Bob Thermometers
R. S. Thermostat Temperature Controls
R. S. High Pressure Consistometer
R. S. Smoke Meters

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— SUBMIT SKETCH OF YOUR PROBLEMS FOR ESTIMATE —

THE REFINERY SUPPLY CO.

Main Office and Plant

621 E. 4th Street **TULSA 3, OKLAHOMA** Ph. 4-8144

Houston Office Temporarily Discontinued

Seedburo Equipment Co., 618 W. Jackson Blvd., Chicago, Ill.
Moisture-testers, ovens, scales, thermometers
(See advertisement on page 16)

Seederer-Kohlbusch, Inc., 27-29 S. Van Brunt St., Englewood, N. J.
Analytical balances & weights

Seely Instrument Co. Inc., 377 4th St., Nigara Falls, N. Y.
Controllers & valves

Sell Electric Co., H. H., 3240 Dakota Ave., Minneapolis 16, Minn.
Phase sequence indicators
(See advertisement on page 74)

Sensitive Research Instrument Corp., 9-11 Elm Ave., Mt. Vernon, N. Y.
Electrical instruments measuring quantities or values of small current or voltage

Serdex, Inc., 91 Cambridge St., Boston 14, Mass.
Meteorological instruments
(See advertisement on page 63)

Service Recorder Co., 1375 Euclid Ave., Cleveland, Ohio
Vehicle recorders
(See advertisement on page 104)

Servo Corp. of America, 2020 Jericho Pike, New Hyde Park, L. I., N. Y.
Servomechanisms, computers, automatic control equipment and aircraft instruments

Servo-Tek Products Co. Inc., 4 Godwin Ave., Paterson, N. J.
Motion, position and speed recorders

Seth Thomas Clock Co., see Thomas, Seth

Shallcross Controls, Inc., 203 W. Wacker Drive, Chicago 6, Ill.
Furnace controls

Shallcross Manufacturing Co., 10 Jackson Ave., Collingdale, Penna.

Rotary Selector Sitches with solid silver contacts, accurate instrument resistors 0.1% — 5%, decade resistances & standards, bridges, telephone transmission test sets, resistance thermometers, bonding testers & special instruments for electrical measurements

Shand & Jurs Co., 917 Carlton St., Berkeley, Calif.
Liquid level gages

Shawmut Engg. Co., 179 Freeport St., Boston 22 Mass.
Abrasion testers

Sheffield Corp., 721 Springfield St., Dayton 1, Ohio
Machine shop gages

Shelby Instrument Co., 321 West 7 St., Long Beach 2, Calif.
Electrical instruments

Sheldon & Co., E. H., Muskegon, Mich.
Laboratory furniture

Sherron Metallic Corp., 1201 Flushing Ave., Brooklyn 6, N. Y.
Electrical testing equipment

Shore Instrument & Mfg. Co., Van Wyck & Carll St., Jamaica 2, N. Y.
Scleroscope hardness testers
(See advertisement on page 98)

Shurite Meters, 61 Hamilton St., New Haven 8, Conn.
Electrical panel & portable instruments

Sickles Co., F. W., Springfield 2, Mass.
Electrical products

Sigma Instruments Inc., 70 Ceylon St., Boston, Mass.
Relays

Signal Electric Mfg. Co., Menominee, Mich.
Fractional horsepower motors

Signal Indicator Co., 894 Broadway, New York 3, N. Y.
Dial lights

Simplex Time Recorder Co., Sanborn St., Gardner, Mass.
Time recording clocks

Simplex Valve & Meter Co., 6787 Upland St., Philadelphia 42, Pa.
Flow controls, meters, gages, proportioning & ratio control equipment

Simpson Electric Co., 5216 Kinzie St., Austin Station, Chicago 44, Ill.
Electrical instruments

Simpson Optical Mfg., 3200 W. Carroll Ave., Chicago 24, Ill
Lenses, prisms, optical flats & complete optical systems
(See advertisement on page 71)

Sinclair Collins Valve Co. 454 Morgan Ave., Akron, Ohio
Automatic controllers and control valves

Size Control Company, 2500 Washington Blvd., Chicago 12, Ill.
Machine shop & special gages, measuring wires

Sjostrom Co., John E., 1711 N. Tenth St., Philadelphia 22, Pa.
Laboratory furniture

Skaneateles Manufacturing Co., Inc., 122 Dickerson St., Syracuse 2, N. Y.
Vacuum gages

Skyway Precision Tool Co., 3217 Casitas Ave., Los Angeles 26, Calif.
Torque testers

Slocomb Co., J. T., 35 Oxford St., Providence 5, R. I.
Micrometer calipers

Small Motors, Inc., 2068 Elston Ave., Chicago 14, Ill.
Universal fractional horsepower motors, dynamotors, shaded pole motors & generators

Smith Control & Instrument Corp., 1329 Highland Ave., Needham 92, Mass.
Thermostats

Smith Meter Co., 5743 Smithway St., Los Angeles 22, Calif.
Gasoline and oil meters
(See advertisement on page 134)

Sodemann Heat & Power Co., 2300 Delmar Blvd., St. Louis 3, Mo.
Air conditioned moist cabinet

Sola Electric Co., 4633 W. 16th St., Chicago 50, Ill.
Transformers, automatic voltage adjusters

Solar Mfg. Corp., 1445 Hudson Blvd., Bergen, N. J.
Capacitors

Soreng Mfg. Corp., 1901 N. Clybourn Ave., Chicago 14, Ill.
Solenoids and switches
(See advertisement on page 20)

Sorensen & Co., Inc., 375 Fairfield Ave., Stamford, Conn.
Chokes, current regulators, voltage regulators, transformers
(See advertisement on page 1)

Sorvall, Ivan, 210 5th Ave., New York 10, N. Y.
Variable transformers

...nd Apparatus Co., Millington, N. J.
...nd measuring equipment

...th Bend Lathe Works, 303 E. Madison St., South ...nd, Ind.
...ecision lathes

...thern Desk Co., Hickory, N. C.
...boratory furniture

...th Specialty Engineering, see Specialty Eng. & ...g. Co.

...thwestern Industrial Electronic Co., 2831 Post ...k Road, Houston 19, Texas
...ysical instruments, industrial controls, electronic ...velopment

...tarling, R. W., Box 3277 Terminal Annex, Los ...ngeles 54, Calif.
...quid meters

...ecialized Instruments Corp., Belmont, Calif.
...tra-speed centrifuges
(See advertisement on page 29)

...ecialty Battery Co., 212 East Washington Ave., ...adison 3, Wis.
...y batteries

...ecialty Engineering and Mfg. Co., 108 E. Dedham St., Boston 18, Mass.
...ecialists in precision engineering and light manu...turing
(See advertisement on page 135)

...ecialty Glass Co., 536 Lake Shore Drive, Chicago ... Ill.
...boratory glassware

...eed-meter Electric Co., 690 Van Ness Ave., San ...rancisco, Calif.
...rvey footmeter

...eidel & Co., Chas. W., 112 N. 12th St., Philadel...hia 7, Pa.
...rveying instruments

...ence Engineering Co., Inc., 53 Grant St., Walden ... Y.
...gulating valves

...erry Gyroscope Co., Inc., Great Neck, N. Y.
...ircraft & marine navigational instruments

...erry Products, Inc., Shelter Rock Road, Danbury, Conn.
...ecial railway testers
(See advertisement on page 98)

...erry-Sun Well Surveying Co., 1600 Walnut St., Philadelphia 3, Pa.
...nderground surveying instruments for oil wells

Sprague Meter Co., 35 South Ave., Bridgeport 4, Conn.
Liquid meters

Spreagnether Instrument Co., W. F., 4567 Swan Ave., St. Louis 10 Mo.
Scientific instruments magnetometers, seismographs
(See advertisement on page 91)

Squires Co., C. E., E. 40th St. & Kelly Ave., Cleveland 3, Ohio.
Feed water regulators & pump governors

Stafford Co., N., 113 53 St., Brooklyn, N. Y.
Nautical, naval & navigation instruments

Standard Arcturus Corp., 99 Sussex Ave., Newark, N. J.
Vacuum tubes

Standard Concrete Apparatus Co., 1422 Rhode Island Ave., Washington 5, D. C.
Concrete testing equipment

Standard Electrical Products Co, 402 E. First St., Dayton 2, Ohio
Relays

Standard Electric Time Co., 89 Logan St., Springfield 2, Mass.
Electric stop clocks, electric time systems, watt hour meter testing equipment, program clocks, laboratory jack panels & small laboratory table service panels
(See advertisement on page 108)

Standard Gage Co., Inc., 70 Parker Ave., Poughkeepsie, N. Y.
Gages for linear measurements

Standard Piezo Co., 127 Cedar St., Carlisle, Pa.
Piezoelectric and quartz crystals

Standard Science Supply Co., 1232 N. Paulina St., Chicago 22, Ill.
Laboratory supplies

Standard Scientific Supply Corp., 34 W. 4 St., New York 12, N. Y.
Laboratory supplies

Standard Thermometer, Inc., 952 Dorchester Ave., Boston, Mass.
Mechanical thermometers

Standard Transformer Corp., Elston-Kedzie-Addison, Chicago 22, Ill.
Transformers

Star Compass Co., 110 Antwerp St., East Milton, Mass.
Compasses

Starrett Co., L. S., Athol, Mass.
Precision tools, dial indicators & steel tapes

States Co., 19, New Park Ave., Hartford 6, Conn.
Electricity meter testers

Statham Laboratories, 9328 Santa Monica Blvd., Beverly Hills, Calif.
Accelerometers, dynamometers, strain gages, flow-meters, pressure indicators, tension indicators

Stebar Co., 711 W. Lake St., Minneapolis 8, Minn.
Microscopes

Steel City Testing Machines, Inc., 8843 Livernois Ave., Detroit 4, Mich.
Testing machines

Sterling Inc., 3738 North Holton, Milwaukee 12, Wisc.
Motor operated valves

Sterling Mfg. Co., 9205 Detroit Ave., Cleveland, Ohio
Battery testers and portable electrical instruments

Stevens-Arnold Co., 22 Elkins St., So. Boston 27, Mass.
Relays, frequency & polarized

Stevens Mfg. Co., Inc., Richland Trust Bldg., Mansfield, Ohio
Controllers, automatic thermostatic, thermostats

Stewart, M. C., Ashburnham, Mass.
Meteorological instruments

Stewart-Warner Corp., 1826 Diversey Parkway, Chicago 14, Ill.
Tachometers and pressure gages

Sticht Co., Inc., Herman H., 27 Park Pl., New York 7, N. Y.
Electrical instruments
(See advertisement on pages 94, 101)

Stocker & Yale, P. O. Box 21, Marblehead, Mass.
Optical instruments

Stillman Co., M. J., Suite 800, 116 So. Michigan Ave., Chicago 3, Ill.
Stop watches

Stoelting, C. H., 424 N. Homan Ave., Chicago 24, Ill.
Laboratory supplies

Stokes Machine Company, F. J., 5820 Tabor Road, Olney P. O., Philadelphia, Pa.
Special process machinery; pressure & vacuum gages; pellet presses; high vacuum pumps; McLeod vacuum gages; automatic water stills

Stokes & Smith Co., Summerdale Ave., near Roosevelt Blvd., Philadelphia 24, Pa.
Automatic filling machines

Streeter-Amet Company, 4101 Ravenswood, Chicago 13, Ill.
Automatic measuring, weighing & counting machines
(See advertisement on page 43)

Stromberg Time Corp., 109 Lafayette St., New York 13, N. Y.
Timing devices & time clocks

Struthers-Dunn, Inc., 150 N. 13 St., Philadelphia 7, Pa.
Relays, timing devices, electric counters, thermostats

Stupakoff Ceramic & Mfg. Co., Latrobe, Pa.
Ceramic thermocouple insulators and protection tubes

Sturtevant Co., P. A., Addison, Ill.
Torque measuring equipment

Sturtevant Mill Co., Harrison Sq., Boston 2, Mass.
Laboratory supplies

Summers Gyroscope Co., 2328 Broadway, Santa Monica, Calif.
Automatic pilots, and gyro servos

Sun Electric Corp., 6323 Avondale Ave, Chicago 31, Ill.
Electrical instruments & engine test equipment

Sun Radio & Electronics Company, 122-124 Duane St., New York 7, N. Y.
Authorized distributors for all major manufacturers of radio parts, tubes, meters, radio test equipment, electronic equipment for industrial use, instruments for laboratory and industrial tst purposes, and electronic components for the construction of such instruments

Sundstrand Machine Tool Co., 2531 11th St., Rockford, Ill.
Balancing machines, pumps, valves

Superior Electric Co., 30 Harrison St., Bristol, Conn.
Industrial & laboratory apparatus

Superior Meter Co., Inc., 167 41st Street, Brooklyn, 32, N. Y.
Gas meters & appliances

Superior Tube Co., P. O. Box 191, Norristown, Pa.
Fine tubing
(See advertisement on page 111)

Supreme Instruments Corp., Greenwood, Miss.
Radio testing equipment; tube testers, set testers, analyzers, test oscillators, oscilloscopes & dynamic instruments
Gages

Surface Checking Gage Co., 1937 Taft Ave., Hollywood, 28, Calif.
Surface roughness standards and comparators

Surface Combustion Corp., 2375 Dorr Ave., Toledo 1, O.
Dew Point Recorder

Surty Mfg. Co., Inc., 4141 W. Kinzie St., Chicago 24, Ill.
Magnifiers

Suter, Alfred, 200 Fifth Ave., New York 10, N. Y.
Testing apparatus for textiles and metals

Suverkrop Instruments, Box 463, Bakersfield, Calif.
Drafting & Surveying instruments

Swanson Tool Machine Products, 810 E. 8th St., Erie Pa.
Bore gages and gage fixtures

Swartwout Co., 18511 Euclid Ave., Cleveland, Ohio
Furnace controllers

Swedish Gage Co. of America, 8900 Alpine Ave., Detroit 4, Mich.
Internal indicators; plug, ring, master disc & special built fixtures

Sylvania Electric Products, Inc., 500 Fifth Ave., New York, N. Y.
Electronic instruments

T

Taber Instrument Corp., 111 Goundry St., North Tonawanda, N. Y.
Testers for measuring wear & abrasion resistance of paints, electroplate, linoleum, leather, textiles; precision stiffness gages for paper, light metallic sheet & wire

Taco-West Corp., 2620 S. Park Ave., Chicago 16, Ill.
Special electronic equipment, electronic controls and automatic machinery

Tagliabue Corp., (N. J.) C. J., 591 Frelinghuysen Ave., Newark, N. J.
Indicating, Recording and Controlling Instruments for Temperature, Pressure, Level, Flow, Humidity; Hydrometers, Chemical Thermometers and Petroleum Testing Instruments; Moisture Meters for Grain, Wood, Tobacco and Granular Materials; Potentiometers, Pyrometers and Resistance Thermometers, Non-Indicating, Recording and Controlling Types; Industrial and Dial-Indicating Thermometers.

Taller & Cooper, Inc., 75 Front St., Brooklyn 1, N. Y.
Wind tunnel instruments, panel boards

Tamms Silica Co., 228 N. LaSalle St., Chicago 1, Ill.
Pyrometers

Taylor & Co., W. A., 7300 York Road, Baltimore 4, Md.
Equipment for pH & chlorine control, control of phosphates in boiler water & for water analysis

Taylor Instrument Cos., 95 Ames St., Rochester 1, N. Y.
Indicating, Recording & Controlling Instruments for Temperature, Humidity, Pressure, Rate of Flow, & Liquid Level
(See advertisement on Outside Front Cover)

Taylor Dynamometer & Machine Co., 3056 West Meinecke Ave., Milwaukee 10, Wis.
Hydraulic dynamometers, static balancing machines, super-accurate drill presses

Technical Associates, 3730 San Fernando Rd., Glendale 4, Calif.
Geiger-Mueller counter equipment; custom built instruments
(See advertisement on page 85)

Technical Products Co., 158 Madison Ave., Memphis 1, Tenn.
Laboratory supply house

Technicon Co., 215 E. 149 St., New York 51, N. Y.
Laboratory apparatus

Technology Instrument Corp., 1058 Main St., Waltham 54, Mass.
Special audio equipment

Tejax Engineering Corp., 2 Allens Ave., Providence, R. I.
Dial indicating handwheels, valve position indicators & V-port hand regulating valves

Complete Control

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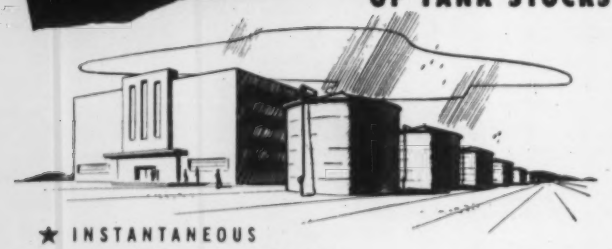

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Cathode ray oscilloscopes & video test equipment
(See advertisement on page 76)

Telechron, Inc., Ashland, Mass.
Timers and fractional horsepower motors

Teletronics Laboratory, 352 Maple Ave., Westbury, N. Y.
Custom design and manufacture of electronic and electro-mechanical devices

Televiso Products Inc., 7466 Irving Park Rd., Chicago 34, Ill.
Electronic products; custom built equipment

Tempil Corp., 132 West 22 St., New York 11, N. Y.
Thermoscopic paint & thermometer sticks

Tenney Engineering Co., 26 Ave. B., Newark 5, N. J.
Controlled temperature & humidity ovens

Testing Instruments, Inc., 43 W. Apple St., Dayton 2, Ohio
Electrical testing instruments for automotive equipment

Testing Machines, Inc., 427 W. 42nd St., New York, N. Y.
Physical testing machines

Testrite Instrument Co., 57 E. 11th St., New York 3, N. Y.
Scientific instruments

Thermal Syndicate Ltd., 12 East 46th St., New York 17, N. Y.
Apparatus, laboratory; flats, optical; gas & vapor discharge tubes, mercury; light sources, mercury vapor; light sources; ultra-violet; optical parts

Therm-O-Disc, Inc., 89 W. Luther Place, Mansfield, Ohio
Thermostats

Thermo-Electric Co., 22-02 Raphael St., Fair Lawn, N. J.
Thermocouples for aircraft engines & industrial uses, extension lead wires & harnesses
(See advertisement on page 100)

Thermo Electric Manufacturing Co., 480 W. Locust St., Dubuque, Iowa
Laboratory furnaces

Thermo Instruments Co., Box 336, Belmont, Calif.
Industrial instruments

Thomas Clock Co., Seth, Industrial Sales Dept., Thomaston, Conn.
Household clocks, outdoor & tower clocks, clock movements for industrial purposes, also electric timers

Thomas Co., Arthur, H., West Washington Square, Philadelphia 5, Pa.
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Thomas & Skinner Steel Products Co., 1118 E. 23rd St., Indianapolis, Ind.
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Thompson Balance Co., 802 E. 18 Ave., Denver 5, Colo.
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Electric stop clocks & interval timers

Thordarson Electric Mfg. Co., 509 W. Huron St., Chicago 10, Ill.
Transformers

Thwing-Albert Instrument Co., Penn St. at Pulaski Ave., Philadelphia 44, Pa.
Pyrometers, paper testing instruments, portable pH meters, general testing instruments & machines

Times Facsimile Corp., 229 West 43 St., New York 18, N. Y.
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Tinsley Laboratories, Inc., 2526 Grove St., Berkeley 4, Calif.
Astronomical instruments, optical instruments

Toledo Scale Co., 1074 Telegraph Rd., Toledo, Ohio
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Tork Clock Co., Inc., Mt. Vernon, N. Y.
Clocks, timers, time controllers

Traceriab, Inc., 55 Oliver St., Boston 10, Mass.
Radioactivity detectors
(See advertisement on page 82)

Transicoil Corp., 114 Worth St., New York 13, N. Y.
Servo motors

Transvision, Inc., New Rochelle, N. Y.
Soldering irons

Trans-Sonics, Inc., Bedford Airport, Bedford, Mass.
Airbourne instrumentation

Trerice Co., H. O., 1420 Lafayette Blvd., W., Detroit 16, Mich.
Industrial instruments

Trimount Instrument Company, 37 W. Van Buren St., Chicago 5, Ill.
Manometers: well type, sliding scale U-tube, fixed scale U-tube, inclined, obsolute pressure, & service gages: draft & mercury pressure; indicating flow meters & tank level indicators
(See advertisement on page 66)

Triner Sales and Service Co., 325 W. Huron St., Chicago 10, Ill.
Scales and service

Trinity Equipment Corp., 472 Westfield Ave., East Roselle Park, N. J.
Thermocouple wells; thermometer test wells; separable sockets for thermometers; drilled, welded and cast protecting tubes; stainless steel laboratory apparatus; special alloy machine products; deep hole drilling of alloy bars; API-ASME code alloy welding and fabrication
(See advertisement on page 101)

Triplett Electrical Instrument Co., Harmon Avenue, Bluffton, Ohio
Electrical measuring instruments & radio testing equipment. Also instruments for laboratory and industrial test purposes; switches, relays, resistors, shunts

Triumph Mfg. Co., 913 W. Van Buren St., Chicago 7, Ill.
Radio test instruments

Troemner, Henry, 911 Arch St., Philadelphia 7, Pa.
Balances

Turner Electric Co., 6138 N. Beechwood St., Philadelphia 38, Pa.
Thermowells

U

C Indicator Co., 624 E. Locust St., Milwaukee 3, Wis.
quid level gages

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...recorders, vacuum recorders, absolute pressure recorders, draft recorders, combined pressure & vacuum recorders, liquid level gages, pressure & vacuum gages, inclined draft gages, well-type direct reading manometers, U-tube manometers, absolute pressure gages
(See advertisement on page 54)

...rig Co., Joseph F., 4101-03 North 5 St., Philadelphia 40, Pa.
...cientific glassware

...anet Co., George, 413-15 Market St., Newark 5, N. J.
...ermostats

...ner Co., J. C., 1791 E. 38th St., Cleveland 14, Ohio
...rveying instruments

...tra-Violet Products, Inc., 5205 Santa Monica Blvd., ...s Angeles 27, Calif.
...uorescence and ultra-violet lamps

...ertl Optical Co., John, 3551-3555 East St., Pittsburgh 14, Pa.
...ptical instruments
(See advertisement on page 73)

...gar Electric Tool Co., Inc., 611-15 Ducommun St., ...s Angeles 54, Calif.
...ectric soldering irons

...iform Tubes, Shurs Lane & Lauriston St., Philadelphia 28, Pa.
...ecision tubes of all metals
(See advertisement on page 112)

...nimax Switch Corp., 460 West 34 St., New York 1, N. Y.
...witches

...nion Tool Company, 48 E. River St., Orange, Mass.
...achine shop gages

...nited Condenser Corp., 422 East 138 St., New York 54, N. Y.
...apacitors

...nited Electric Controls Co., 71 A St., Boston 27, Mass.

...nited Electronics Co., 42 Spring St., Newark 2, N. J.
...acuum capacitors and vacuum tubes

...nited Precision Products Co., Inc., Shabbona, Ill.
...ages

United States Blue Print Paper Co., 207 S. Wabash Ave., Chicago 4, Ill.
Surveying instruments

United States Gauge Div., American Machine & Metals, Sellersville, Pa.
Indicating & recording pressure gages

United States Instrument Corp., 409 Broad St., Summit, N. Y.
Voice powered telephone equipment

United States Taximeter Co., Div. of Weisinger Recording Instruments Corp., 503 W. 54th St., New York 19, N. Y.
Speedometers, tachometers, taxi meters

United Transformer Corp., 150 Varick St., New York 13, N. Y.
Transformers

Universal Drafting Machine Co., 3110 Payne Ave., Cleveland, Ohio
Drafting Machines

Universal X-Ray Products, 1140 Western Ave., Chicago 22, Ill.
Barometers, manometers, vacuum gages, X-ray equipment

Univis Lens Company, 401 Leo St., Dayton 1, Ohio
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V

Vacutron, Inc., 2819 12th St., So., Arlington, Va.
Special vacuum tubes; electronic circuits & industrial control devices

Vacuum Electronics Engg. Co., 37 St. and 3rd Ave., Brooklyn, N. Y.
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Valpey Crystals, 1244 Highland St., Holliston, Mass.
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Valvair Corp., 454 Morgan Ave., Akron 11, Ohio
Control valves

Valve Pilot Corp., 230 Park Ave., New York 17, N. Y.
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Valverde Labs., 91 Crosby St., New York 12, N. Y.
Thermal controls

Van Dyke Instruments, Inc., Box 696, Taranza, Calif.
Laboratory apparatus

Van Keuren Co., 176 Waltham St., Watertown, Mass.
Optical comparators & flats

Van Wagner Co., 89-04 113 St., Richmond Hill 18, N. Y.
Inspection devices

Vapor Recovery Systems Co., 2820 N. Alameda St., Compton, Calif.
Liquid level gages, manometers, remote metering equipment and control valves
(See advertisement on page 53)

Varo Mfg. Co., Box 638, Garland, Texas
Electronic instruments

Vaughn-G. E. Witt Co., 4228 Hollis St., Emeryville, Calif.
Regulating valves

Veeder-Root, Inc., Sargent & Garden Sts., Hartford 2, Conn.
Electrically operated counting devices, a.c. and d.c.

Vickers Electric Div., Vickers Inc., 1815 Locust St. St. Louis 3, Mo.
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Vickers, Inc., 1400 Oakman Blvd., Detroit 32, Mich.
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Victoreen Instrument Co., 5806 Hough Ave., Cleveland 3, Ohio
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Viking Instruments Inc., East Haddam, Conn.
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Visco-Meter Corp., 315 Grote St., Buffalo 7, N. Y.
Viscosimeter

Voland & Sons, Inc., New Rochelle, N. Y.
Analytical balances & weights

W

Wagner & Son, Carl H., 1944 N. Albany Ave., Chicago 47, Ill.
Thermometers

Walker & Co., Geo. T., 324 Fifth Ave., South, Minneapolis 15, Minn.
Laboratory supplies

Walker-Jimieson, Inc., 311 S. Western Ave., Chicago 12, Ill.
Radio & electronic supplies

Wallace & Tiernan Products, Inc., P. O. Box 178, Belleville 1, N. J.
Chlorine control & chemical feed devices, meteorological instruments
(See advertisement on page 3)

Walser Automatic Timer Corp., 420 Lexington Ave., New York 17, N. Y.
Timers

Waltham Dial Gage Co., Boxboro Road, Stow, Mass.
Machinist's dial gages

Waltham Watch Co., Waltham, Mass.
Stop watches

Ward Leonard Electric Co., 31 South St., Mount Vernon, N. Y.
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Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio
Telescopes

Warren-Knight Co., 136 N. 12th St., Philadelphia 7, Pa.
Surveying instruments & equipment

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We can make, assemble and test your full or sub-assembly parts to your specifications with ingenuity and at costs surprising to you.
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Weber & Co., F., 1220 Buttonwood St., Philadelphia 23, Pa.
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Weiler, Paul G., 95 Broad St., New York 4, N. Y.
Resistance thermometers

Weksler Thermometer Corp., 52-56 West Houston St., New York 12, N. Y.
Thermometers, hydrometers, psychrometers
(See advertisement on page 105)

Welch Scientific Co., W. M., 1515 Sedwick St., Chicago 10, Ill.
Electrical instruments, vacuum pumps & items for science laboratories
(See advertisement on page 43)

Weltronic Co., 19500 West Eight Mile Road, Detroit 19, Mich.
Current regulators

Welwyn Electronic Components, Inc., 234 E. 46th St., New York 17, N. Y.
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West Coast Electronics Co., 1601 S. Burlington St., Los Angeles 6, Calif.
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Westberg Mfg. Co., 6502 Onarga St., Chicago 31, Ill.
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Westinghouse Electric Corp., 306 4th Ave., P. O. Box 1017, Pittsburgh 30, Pa.
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Westinghouse X-Ray Co. Inc., 2519 Wilkins Ave., Baltimore 3, Md.
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Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.
Switchboard, panel & portable measuring instruments. Industrial & radio test equipment.
Light measuring instruments and photographic exposure meters. Also dial type industrial temperature gages, control relays and aircraft instruments.

Wheaton Co., T. C. Millville, N. J.
Glassware

Wheastone Corp., 2819 Reading Rd., Cincinnati 2, Ohio
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Wheelco Instruments Co., 847 W. Harrison St., Chicago, Ill.
Temperature, indicating, recording & control instruments, temperature limit & shut-off device; automatic combustion safeguards
(See advertisement on pages 31, 84)

White Co., Inc., David, 315 W. Court St., Milwaukee 12, Wis.
Surveying instruments

White-Rodgers Electric Co., 1209 Cass Ave., St. Louis 6, Mo.
Furnace controls

Wilcolator Co., 1001 Newark Ave., Newark B, N. J.
Thermostats

Wilder Inc., R. S., 26 Bedford St., Waltham, Mass.
Microprojector

Wilder Sales Co., 15 Euclid Ave., Troy, N. Y.
Thermometers

Wilkening Mfg. Co., 1908 S. 71st St., Philadelphia 42, Pa.
Piston ring gages

Wilkens-Anderson Co., 111 N. Canal St., Chicago 6, Ill.
Laboratory supplies

Will Corp., 39 Russell St., Rochester 3, N. Y.
Laboratory supplies & apparatus

Williams Apparatus Co., Inc., Herald Bldg., Watertown, N. Y.
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Williams, Brown & Earle, Inc., 918 Chesnut St., Philadelphia 7, Pa.
Laboratory supplies

Williams Gauge Co. 1620 Pennsylvania Ave., Pittsburgh 12, Pa.
Water level gages

Willson Products, Inc., Reading, Penna.
Anemometers

Wilmotte, Inc., Raymond M., 1469 Church St., N. W. Washington, D. C.
Electronic gaging instruments

Wilson & Co., G. C., P. O. Box 389, Chatham, N. J.
Remote-control and remote-metering equipment

Wilson Mechanical Instrument Co., Inc., 3 Concord Ave., New York 54, N. Y.
Hardness testers

Winchester Electronics Co., 6 E. 46th St., New York 17, N. Y.
Connectors, plugs, clips, posts, jacks

Winslow Co., Inc., 9 Liberty St., Newark 5, N. J.
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Wollensak Optical Co., 880 Hudson Ave., Rochester 3, N. Y.
Optical instruments
Wood Counter Lab., N. 5646 S. Harper St., Chicago 37, Ill.

Woods "Lab. Apparatus", F. W., 140-6 Warden St., Pittsburgh 20, Pa.
Biological laboratory supplies

Woods Hole Oceanographic Inst., Woods Hole, Mass.
Oceanographic instruments

Woodworth Co., N. A., 1365 Jarvis Ave., Detroit 29, Mich.
Gages for physical measurements

Worley Jewel Co., John, Waltham, Mass.
Jewels & pivots

Worner Electronic Devices, Rankin, Ill.
Photoelectric products

Worthington Pump & Machinery Corp., Harrison, N. J.
Liquid meters

Wroble Engineering Co., 1067 Davis Terrace, Schenectady 3, N. Y.
Universal testing machines

Wyland, George C., Center St., Ramsey, N. J.
X-Ray tubes & cameras

Y

Yale & Towne Mfg. Co., Kron Div., 4530 Tacony St., Philadelphia 24, Pa.
Scales

Yankee Precision Products Co., 50 Bartholomew Ave., Hartford 6, Conn.
Gages & electronic inspection devices

Yardeny Engineering Co., 105-107 Chambers St., New York 7, N. Y.
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Yarnall-Waring Company, 102 E. Mermaid Lane, Chestnut Hill, Philadelphia 18, Pa.
Water columns, water gages & blow-off valves for steam boilers, spray nozzles for liquids & hydraulic valves for presses

Yellow Springs Instrument Co., Inc., Box 211, Yellow Springs, Ohio
Construction of special instruments

Yoder Company, 5500 Walworth Ave., Cleveland, Ohio
Cement testers

Yonkers Lab. Supply Co., 515 W. 132 St., New York 27, N. Y.
Laboratory supplies

York Ice Machinery Corp., York, Pa.
High altitude test & calibration chambers

Z

Zeiss, Inc., Carl, 485 Fifth Ave., New York 17, N. Y.
Optical instruments

Zenith Optical Co., Huntington 19, W. Va.
Microscopes, lenses, optical flats

Zenith Optical Laboratory, 123 W. 64th St., New York 23, N. Y.
Lenses, mirrors

Zernickow Co., O., 15 Park Row, New York 7, N. Y.
Tachometers, tachographs, tachoscopes, cutmeters, stop watches

Zuhr, Inc., Henry, 237 Lafayette St., New York, N. Y.
Laboratory test instruments

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CONTROL VALVES for every Process Application

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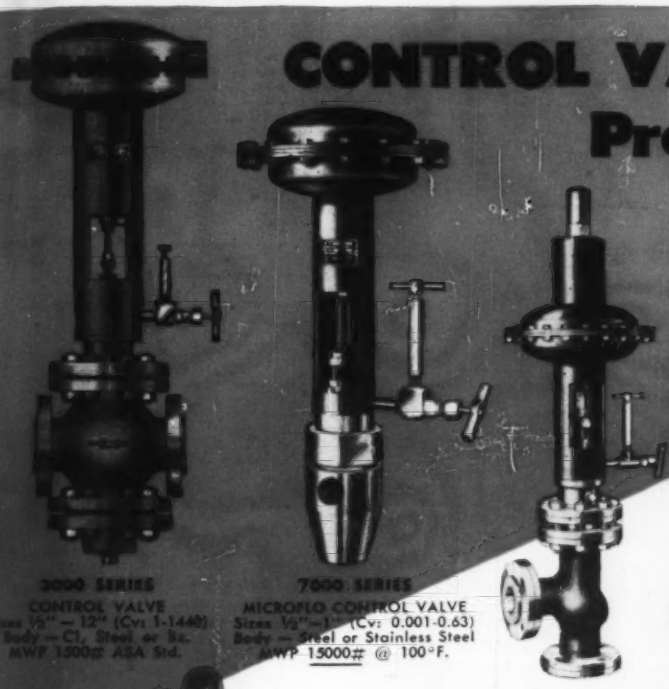

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CONTROL VALVE
Sizes ½" — 12" (Cv: 1-1440)
Body — CI, Steel or Ss.
MWP 1500# ASA Std.

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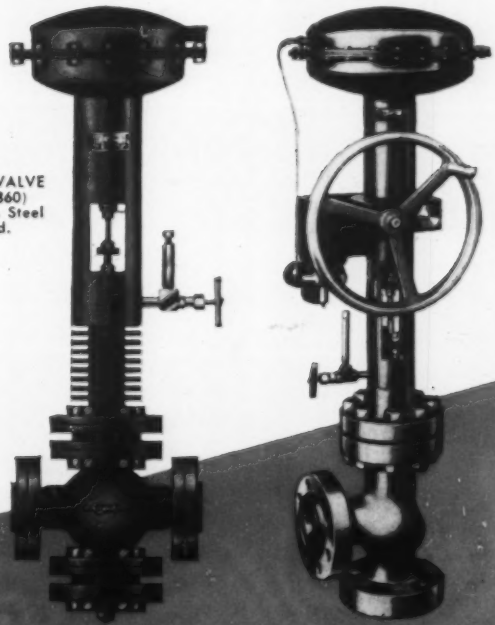
Sizes ½" — 1" (Cv: 0.001-0.63)
Body — Steel or Stainless Steel
MWP 15000# @ 100°F.



7000A SERIES
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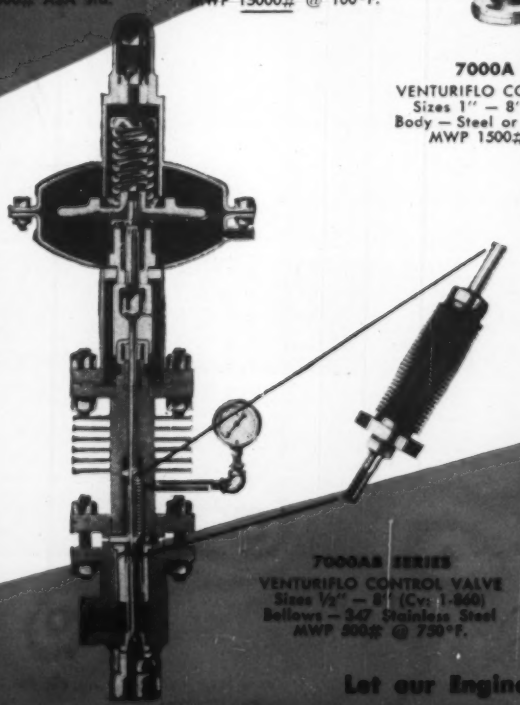
Sizes 1" — 8" (Cv: 1-860)
Body — Steel or Stainless Steel
MWP 1500# ASA Std.



7000AB SERIES
VENTURIFLO CONTROL VALVE
Sizes ½" — 8" (Cv: 1-860)
Bellows — 347 Stainless Steel
MWP 800# @ 750°F.

3000BX SERIES
ALLOY CONTROL VALVE
Sizes ½" — 10" (Cv: 1-1000)
BODY — Any Castable Alloy
MWP 300# ASA Std.

7000HP SERIES
VENTURIFLO CONTROL VALVE
Sizes 1" — 8" (Cv: 1-860)
Body — Steel or Stainless Steel
MWP 1500# ASA Std.

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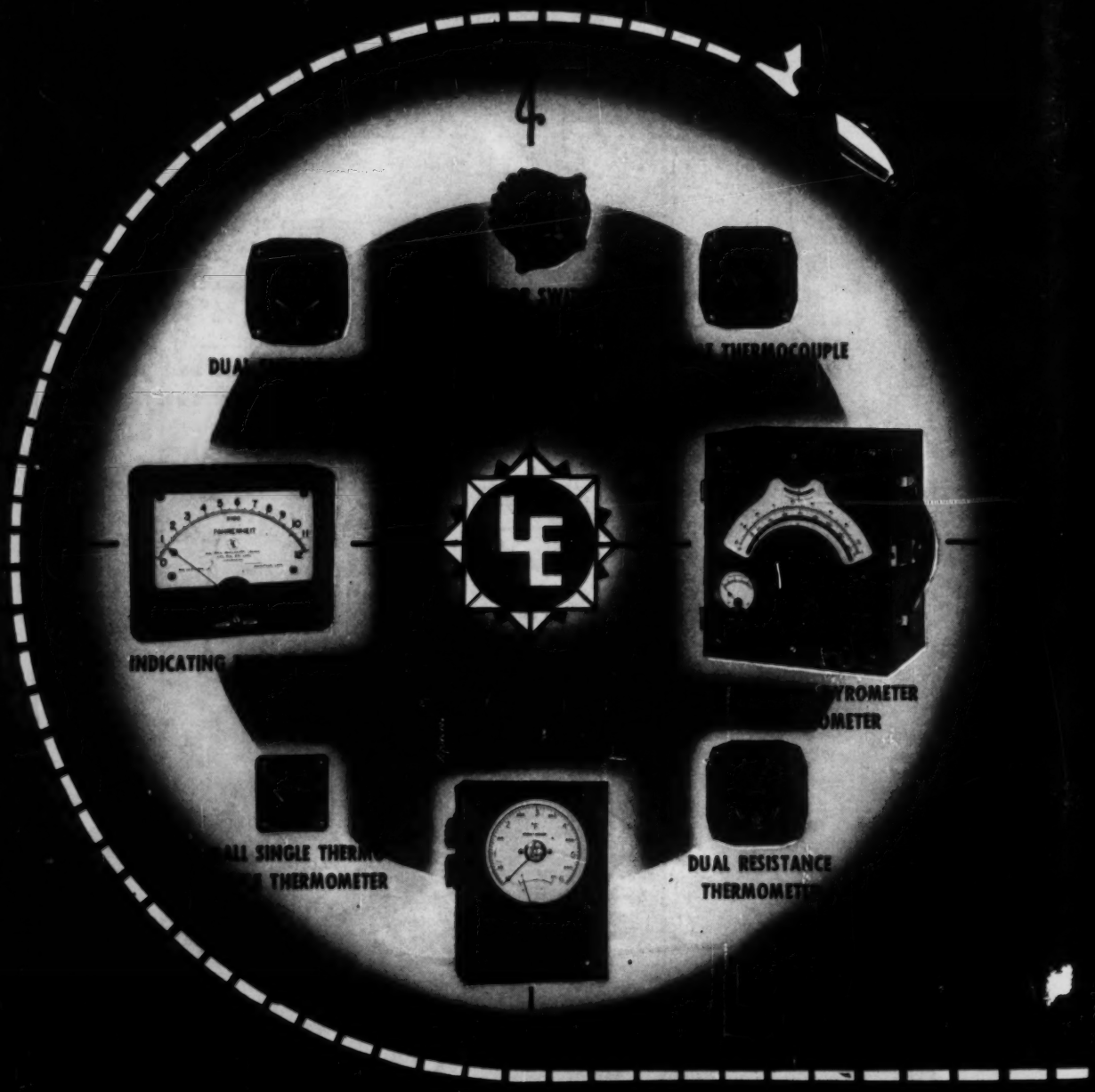
In Canada, Railway & Power Engineering Corporation, Ltd.

LEWIS TEMPERATURE INSTRUMENTS



If it moves on land, sea or air, you can be fairly sure that the original tests to determine the suitability of its power plant were made with Lewis instruments.

THE LEWIS ENGINEERING CO.

Specialists in Electrical Temperature Measurements

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